IDAHO—PM–10 NONATTAINMENT AREAS

Designated area	Designation		Classification	
	Date	Type	Date	Type
* * * *	*	*		*
Shoshone County				
a. Northwest quarter of the Northwest quarter, Section 8, Township 48 North, Range 2 East; Southwest quarter of the Northwest quarter, Section 8, Township 48 North, Range 2 East; Northwest quarter of the Southwest quarter, Section 8, Township 48 North, Range 2 East; Southwest quarter of the Southwest quarter, Section 48 North, Range 2 East, Boise Base (known as ''Pinehurst expansion area'').	1/20/94	Nonattainment	1/20/94	Moderate.
b. City of Pinehurst	11/15/90	Nonattainment	11/15/90	Moderate.
* * * *	*	*		*

[FR Doc. 95–11505 Filed 5–10–95; 8:45 am]

BILLING CODE 6560–50–P

40 CFR Part 228

[FRL–5204–6]

Ocean Dumping; Final Site Designation

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: EPA today designates an Ocean Dredged Material Disposal Site (ODMDS) in the Gulf of Mexico offshore Tampa, Florida, as an EPA-approved ocean dumping site for the disposal of suitable dredged material. This action is necessary to provide an acceptable ocean disposal site for consideration as an option for dredged material disposal projects in the greater Tampa, Florida vicinity. This site designation is for an indefinite period of time, but the site is subject to continuing monitoring to insure that unacceptable adverse environmental impacts do not occur.

EFFECTIVE DATE: This designation shall become effective on June 12, 1995.

ADDRESSES: Wesley B. Crum, Chief, Coastal Programs Section, Water Management Division, U. S. Environmental Protection Agency, Region IV, 345 Courtland St, NE., Atlanta, Georgia 30365.

FOR FURTHER INFORMATION CONTACT: Gary W. Collins, 404/347–1740 ext. 4286.

SUPPLEMENTARY INFORMATION:

A. Background

Section 102(c) of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, as amended, 33 U.S.C. 1401 *et seq.*, gives the Administrator of EPA the authority to designate sites where ocean disposal may be permitted. On October 1, 1986, the Administrator delegated the authority to designate ocean disposal sites to the Regional Administrator of the Region in which the sites are located. This designation of a site offshore Tampa, Florida, which is within Region IV, is being made pursuant to that authority.

The EPA Ocean Dumping Regulations promulgated under MPRSA (40 CFR chapter I, subchapter H, § 228.4) state that ocean dumping sites will be designated by promulgation in this part 228. A list of ''Approved Interim and Final Ocean Dumping Sites'' was published on January 11, 1977 (42 FR 2461 (January 11, 1977)). The list established two sites for Tampa, Site A and Site B, as interim sites. Subsequent legal action by Manatee County and extensive field efforts have resulted in the identification of the now proposed site. The details of these events can be found in the ''Final Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Tampa, Florida.''

B. EIS Development

Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969, as amended, 42 U.S.C. 4321 *et seq.*, requires that federal agencies prepare an Environmental Impact Statement (EIS) on proposals for legislation and other major federal actions significantly affecting the quality of the human environment. The object of NEPA is to build into the Agency decision making process careful consideration of all environmental aspects of proposed actions. While NEPA does not apply to EPA activities of this type, EPA has voluntarily committed to prepare EISs in connection with ocean disposal site designations such as this (see 39 FR 16186 (May 7, 1974)).

EPA, in cooperation with the Jacksonville District of the U.S. Army Corps of Engineers (COE), has prepared a Final EIS (FEIS) entitled ''Final Environmental Impact Statement for the Designation of An Ocean Dredged Material Disposal Site Located Offshore Tampa, Florida.'' On September 23, 1994, the Notice of Availability (NOA) of the FEIS for public review and comment was published in the **Federal Register** (59 FR 48878 (September 23 1994)). Anyone desiring a copy of the EIS may obtain one from the address given above. The public comment period on the final EIS closed on October 24, 1994. The closing date was extended for 15 days due to a request by the State of Florida.

EPA received 1 comment letter on the Final EIS. The letter was from the State of Florida (dated November 18, 1994) and stated that the proposed designation was found to be consistent with the Florida Coastal Management Program.

This rule permanently designates the continued use of the previously designated Site 4 near Tampa, Florida. The purpose of the action is to provide an environmentally acceptable option for the ocean disposal of dredged material. The need for the permanent designation of the Tampa ODMDS is based on a demonstrated COE need for ocean disposal of maintenance dredged material from the Federal navigation projects in the greater Tampa Bay area. However, every disposal activity by the COE is evaluated on a case-by-case basis to determine the need for ocean disposal for that particular case. The need for ocean disposal for other projects, and the suitability of the material for ocean disposal, will be determined on a case-by-case basis as part of the COE's process of issuing permits for ocean disposal for private/federal actions and a public review process for their own actions.

For the Tampa ODMDS, the COE and EPA would evaluate all federal dredged material disposal projects pursuant to the EPA criteria given in the Ocean Dumping Regulations (40 CFR parts 220 through 229) and the COE regulations (33 CFR 209.120 and parts 335–338). The COE then issues Marine Protection, Research, and Sanctuaries Act (MPRSA) permits after compliance with regulations is determined to private applicants for the transport of dredged material intended for ocean disposal. EPA has the right to disapprove any ocean disposal project if, in its judgment, the MPRSA environmental criteria (Section 102(a)) or conditions of designation (Section 102(c)) are not met.

The FEIS discusses the need for this site designation and examines ocean disposal site alternatives to this action.

Non-ocean disposal options have been examined and are discussed in the FEIS.

EPA proposed the designation of this site on January 13, 1995 (60 FR 3186). The public comment period expired on February 27, 1995. Only one letter was received on the proposed designation of the Tampa ODMDS. The letter, from the U. S. Department of the Interior (DOI), expressed concern that some of the material may come from portions of the channel that lie within the Federal Outer Continental Shelf (OCS) and the need to inform the DOI's Minerals Management Service (MMS) of such activities. The DOI also expressed concern that material coming from the OCS and used for activities such as beach nourishment could not be removed without a mineral lease issued by MSS. EPA believes that these comments are pertinent only to the COE's permitting action that is discussed previously and no response is needed.

C. Site Designation

The site is located west of Tampa, Florida, approximately 18 nautical miles (nmi) offshore. The ODMDS occupies an area of about 4 square nautical miles (nmi^2), in the configuration of an approximate 2 nmi by 2 nmi square.

Water depths within the area average 22 meters (m). The coordinates of the Tampa site are as follows:

27°32′27″ N	83°06′02″ W;
27°32′27″ N	83°03′46″ W;
27°30′27″ N	83°06′02″ W; and
27°30′27″ N	83°03′46″ W.

D. Regulatory Requirements

Pursuant to the Ocean Dumping Regulations, 40 CFR 228.5, five general criteria are used in the selection and approval for continuing use of ocean disposal sites. Sites are selected so as to minimize interference with other marine activities, to prevent any temporary perturbations associated with the disposal from causing impacts outside the disposal site, and to permit effective monitoring to detect any adverse impacts at an early stage. Where feasible, locations off the Continental Shelf and other sites that have been historically used are to be chosen. If, at any time, disposal operations at a site cause unacceptable adverse impacts, further use of the site can be restricted or terminated by EPA. The site conforms to the five general criteria.

In addition to these general criteria in § 228.5, § 228.6 lists the 11 specific criteria used in evaluating a disposal site to assure that the general criteria are met. Application of these 11 criteria constitutes an environmental assessment of the impact of disposal at the site. The characteristics of the site were reviewed in the proposed rule in terms of these 11 criteria (the EIS may be consulted for additional information).

E. Site Management

Site management of the Tampa ODMDS is the responsibility of EPA as well as the COE. The COE issues permits to private applicants for ocean disposal; however, EPA/Region IV assumes overall responsibility for site management.

The Site Management and Monitoring Plan (SMMP) for the Tampa ODMDS was developed as a part of the process of completing the EIS. This plan, the result of partnering of the federal, state and local authorities who have an interest in ocean disposal and the protection of marine resources, provides procedures for both site management and for the monitoring of effects of disposal activities. The SMMP Team will meet regularly to review the site activities and make recommendations to EPA and the COE on future management and monitoring of the ODMDS. This SMMP is intended to be flexible and may be modified by the responsible agency for cause. Copies of the SMMP are available either separately or as part of the EIS at the address given above.

F. Site Designation

The EIS concludes that the site may appropriately be designated for use. The site is compatible with the 11 specific and 5 general criteria used for site evaluation.

The designation of the Tampa site as an EPA-approved ODMDS is being published as Final Rulemaking. Overall management of this site is the responsibility of the Regional Administrator of EPA/Region IV.

It should be emphasized that, if an ODMDS is designated, such a site designation does not constitute EPA's approval of actual disposal of material at sea. Before ocean disposal of dredged material at the site may commence, the COE must evaluate a permit application according to EPA's Ocean Dumping Criteria. EPA has the right to disapprove the actual disposal if it determines that environmental concerns under MPRSA have not been met.

The Tampa ODMDS is not restricted to disposal use by federal projects; private applicants may also dispose suitable dredged material at the ODMDS once relevant regulations have been satisfied. This site is restricted, however, to suitable dredged material from the greater Tampa, Florida vicinity.

G. Regulatory Assessments

Under the Regulatory Flexibility Act, EPA is required to perform a Regulatory Flexibility Analysis for all rules that may have a significant impact on a substantial number of small entities. EPA has determined that this action will not have a significant impact on small entities since the designation will only have the effect of providing a disposal option for dredged material. Consequently, this Rule does not necessitate preparation of a Regulatory Flexibility Analysis.

Under Executive Order 12866, EPA must judge whether a regulation is ''major'' and therefore subject to the requirement of a Regulatory Impact Analysis. This action will not result in an annual effect on the economy of $100 million or more or cause any of the other effects which would result in its being classified by the Executive Order as a ''major'' rule. Consequently, this Rule does not necessitate preparation of a Regulatory Impact Analysis.

This Final Rule does not contain any information collection requirements subject to Office of Management and Budget review under the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 *et seq.*

List of Subjects in 40 CFR Part 228

Environmental protection, Water pollution control.

Patrick M. Tobin,

Acting Regional Administrator.

In consideration of the foregoing, subchapter H of chapter I of title 40 is amended as follows:

PART 228—[AMENDED]

1. The authority citation for part 228 continues to read as follows:

Authority: 33 U.S.C. 1412 and 1418.

2. Section 228.15 is amended by adding paragraph (h)(18) to read as follows:

§ 228.15 Dumping sites designated on a final basis.

*   *   *   *   *

(h) * * *

(18) Tampa, Florida; Ocean Dredged Material Disposal Site ________ Region IV.

(i) Location:

27°32′27″ N	83°06′02″ W;
27°32′27″ N	83°03′46″ W;
27°30′27″ N	83°06′02″ W;
27°30′27″ N	83°03′46″ W.

(ii) Size: Approximately 4 square nautical miles.

(iii) Depth: Approximately 22 meters.

(iv) Primary use: Dredged material.

(v) Period of use: Continuing use.

(vi) Restriction: Disposal shall be limited to suitable dredged material from the greater Tampa, Florida vicinity. Disposal shall comply with conditions set forth in the most recent approved Site Management and Monitoring Plan.

* * * * *

[FR Doc. 95–11678 Filed 5–10–95; 8:45 am]

BILLING CODE 6560–50–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

43–CFR Public Land Order 7142

[NV–930–1430–01; NV–56315]

Withdrawal of Public Land for Administrative Site; Nevada

AGENCY: Bureau of Land Management, Interior.

ACTION: Public Land Order.

SUMMARY: This order withdraws 40 acres of public land from surface entry and mining for a period of 20 years for the Bureau of Land Management to protect the Las Vegas Administrative Site in Clark County.

EFFECTIVE DATE: May 11, 1995.

FOR FURTHER INFORMATION CONTACT: Dennis Samuelson, BLM Nevada State Office, P.O. Box 12000, Reno, Nevada 89520, 702–785–6507.

By virtue of the authority vested in the Secretary of the Interior by Section 204 of the Federal Land Policy and Management Act of 1976, 43 U.S.C. 1714 (1988), it is ordered as follows:

1. Subject to valid existing rights, the following described public land is hereby withdrawn from settlement, sale, location, or entry under the general land laws, including the United States mining laws (30 U.S.C. Ch. 2 (1988)), to protect the Bureau of Land Management Las Vegas Administrative Site:

Mount Diablo Meridian

T. 20 S., R. 60 E.,
Sec. 22, SE¼NW¼.

The area described contains 40 acres in Clark County.

2. The withdrawal made by this order does not alter the applicability of those public land laws governing the use of the lands under lease, license, or permit, or governing the disposal of their mineral or vegetative resources other than under the mining laws.

3. This withdrawal will expire 20 years from the effective date of this order unless, as a result of a review conducted before the expiration date pursuant to Section 204(f) of the Federal Land Policy and Management Act of 1976, 43 U.S.C. 1714(f) (1988), the Secretary determines that the withdrawal shall be extended.

Dated: May 1, 1995.

Bob Armstrong,

Assistant Secretary of the Interior.

[FR Doc. 95–11639 Filed 5–10–95; 8:45 am]

BILLING CODE 4310–HC–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 675

[Docket No. 95026040–5040–01; I.D. 050595C]

Groundfish of the Bering Sea and Aleutian Islands Area; Pacific Cod by Vessels Using Hook-and-Line Gear

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Closure.

SUMMARY: NMFS is closing the entire Bering Sea and Aleutian Islands management area (BSAI) to directed fishing with hook-and-line gear for Pacific cod. This action is necessary because U.S. fishing vessels participating in the Pacific cod hook-and-line fishery in the BSAI have caught the second seasonal bycatch allowance of Pacific halibut.

EFFECTIVE DATE: 12 noon, Alaska local time (A.l.t.), May 7, 1995, until 12 noon, A.l.t., September 1, 1995.

FOR FURTHER INFORMATION CONTACT: Andrew N. Smoker, 907–586–7228.

SUPPLEMENTARY INFORMATION: The groundfish fishery in the BSAI exclusive economic zone is managed by NMFS according to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands (FMP) prepared by the North Pacific Fishery Management Council under authority of the Magnuson Fishery Conservation and Management Act. Fishing by U.S. vessels is governed by regulations implementing the FMP at 50 CFR parts 620 and 675.

The second seasonal 1995 Pacific halibut bycatch mortality allowance for the hook-and-line Pacific cod fishery, which is defined at § 675.21(b)(2)(ii)(A), is 40 metric tons (60 FR 12149, March 6, 1995.

The Director, Alaska Region, NMFS, has determined, in accordance with § 675.21(d), that U.S. fishing vessels participating in the Pacific cod hook-and-line fishery in the BSAI have caught the second seasonal bycatch allowance of Pacific halibut. Therefore, NMFS is closing the entire BSAI to directed fishing with hook-and-line gear for Pacific cod.

Directed fishing standards for applicable gear types may be found in the regulations at § 675.20(h).

Classification

This action is taken under 50 CFR 675.21 and is exempt from review under E.O. 12866.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: May 5, 1995.

Richard W. Surdi,

Acting Director, Office of Fisheries Conservation and Management, National Marine Fisheries Service.

[FR Doc. 95–11578 Filed 5–5–95; 4:24 pm]

BILLING CODE 3510–22–P

Comments raised during 4/19/2000 meeting and responses

1. The interest in the document is the alternatives analysis, to this end continued discussion is needed.

Response: Continued discussion is anticipated as well as additional revisions to the Dredged Material Management Strategy.

2. There is a need to identify specific beneficial uses.

Response: The ‘Conclusions’ section of the report contains a list of beneficial uses.

3. Information needs to be added on the proposed the anchorage area study.

Response: Information on the anchorage area study has been added to the report.

4. At the top of page 2, recommend changing the word “advising” to “directing”.

Response: The word “advising” has been changed to “directing” on page 2.

5. Add Hillsboro County to the list of data contributors (p.3).

Response: Hillsborough County has been added to the list of contributors on p. 3.

6. Data is lacking on the quality of the dredged material. Data may be available from Tampa Port Authority (historical data and new data [Berths 30 and 26]), the City of Tampa, and the Florida Department of Environmental Protection (FDEP) (marinas, private canals).

Response: Data on quality has been requested and will be added to the DMMS when it is received.

7. On page 11, in the write-up on Table 7, elaborate on chemical testing for Corps projects. Mention the inland testing manual and other documents available for guidance on chemical testing.

Response: Reference to the chemical testing guidance has been added to both the table and the report.

8. Information on dredged material quality (Table 7) could be presented as “flagged chemicals of concern” or “no chemicals of concern identified”. References to laboratory analysis reports or websites could be included, with a

contact person listed. Change the column heading in Table 7 to “Chemical Concerns”.

Response: The column heading has been changed. Additional columns have been added for report or website references and for points of contact. This information has been added where possible.

9. Add a discussion on turbidity monitoring.

Response: A discussion has been added on turbidity monitoring.

10. Check the general figures for material removed against the Tampa Port Authority dredged material management plan. Check the scope of this plan versus the Dredged Material Management Strategy. Is bulking a factor in the figures for removal and placement?

Response: Table 1 of the report contains columns with data for shoal estimates from the Jacksonville District dredging history database, the 1992 Jacksonville District Disposal Area Study, and the Tampa Port Authority Dredged Material Management Plan (DMMP). The DMMP covers “those portions of the Tampa Bay deepwater port system in Hillsborough county north of the Gadsden Point widener, including Hillsborough Bay, Old Tampa Bay, and the northernmost portion of Tampa Bay. The DMMS covers Tampa Bay as defined by the National Estuary Program, as shown in Figure 1. The coverage of the DMMP is a subset of the coverage of the DMMS, and the sum of the shoal estimates in the DMMP is less than that in the DMMS. The shoal estimates from the Jacksonville District dredging database are pay quantities wherever possible, as opposed to being bid volumes. As stated on page 5 of the DMMS, “pay quantities are determined subsequent to dredging and may be more accurate estimates of the quantity of material removed since they are computed after dredging has taken place.” Volumes of material presented in the DMMP are both pay quantities and bid volumes. Bulking should not be a factor for the pay quantities.

11. FDEP requires upland disposal for small projects. A copy of the regulation stating so would be a good addition to the DMMS. Should it be assumed that private dredging needs to find its own sites? Can sites be open to all?

Response: Dredging and disposal are regulated by international treaty, Federal law, and State law and policy. A section explaining these regulations could be included in the DMMS. A description of the permitting framework and process could be included, as well as a description of the permit application process. One of the items for further study is regulations and policy.

12. Verify that Clam Bayou is included in the DMMS as a restoration site (1 million cubic yards to be dredged in the next five years). If it is not, add it.

Response: Clam Bayou, St. Petersburg, Pinellas County, has been added as a restoration site along with the 1,000,000 cubic yard figure.

13. How often will the DMMS be updated. What funding mechanism will be used for the updates?

Response: No schedule has been set for updating the DMMS. Changes pertaining to Federal projects could be made using operations and maintenance funds as the changes occur.

14. Produce a better map showing all of the placement areas currently used. Include distances on the map.

Response: Figure 14 has been revised to show all the existing, approved placement areas. A scale is provided on the map.

15. Add the habitat restoration sites figure.

Response: Once the habitat restoration figure is made available it will be added to the plan.

16. Verify that Ben T. Davis beach is listed as a placement area. If not, add it.

Response: The entries in the table “Northshore Park” and “Northshore Beach”, Pinellas County, have been removed. The entry “Ben T. Davis Beach”, Hillsborough County, has been added.

17. Add a list of dredging research/information/publications websites.

Response: A list has been added.

18. Is a 30% shortfall common among other areas of the country?

Response: While the magnitude of shortfalls could not be determined, other areas expect to face shortfalls. Discussion on other areas of the country (San Francisco and New York) has been added to the report.

19. From where is the Tampa Bay shortfall coming (Federal projects, non-Federal projects)?

Response: The shortfall is anticipated for dredging done in areas north of Cut G of the Federal project. The shortfall affects both Federal and non-Federal projects.

20. Should the shortfall be a wakeup to the community?

Response: Yes, the shortfall should be a wakeup to the community. A shortfall might trigger inability to maintain sufficient depths for commerce.

21. Add to the syllabus that the 2-D and 3-D capacity figures take raising the dikes into consideration.

Response: In the syllabus the figures do not take raising the dikes into consideration. Such wording has been added to the syllabus.

22. Add to the logistical problems/permitting problems possible conflicts between filling holes for beneficial use and recreational fishing.

Response: Wording to this effect has been added to the main text of the report.

23. Redo the maps to show the Federal projects on current maps.

Response: Map revision would enable an accurate depiction of present conditions and would be expensive and time-consuming. The expense and duration of such a task are beyond the scope of the present effort.

24. Generate one map that shows sources of dredged material and placement areas.

Response: Refer to response for comment 23.

25. Give consideration to how far one can go from a potential placement area to obtain material for that area.

Response: Consideration is given when evaluating placement areas to determine a least cost method. Traditionally, material south of Cut G is most inexpensively placed in the ocean site, material between Cut G and Cut C (Hillsborough Bay) is most inexpensively placed in CMDA 3-D, and material north of Cut C (Hillsborough Bay) is most inexpensively placed in CMDA 2-D.

Comments from Roy R. Lewis III, Professional Wetland Scientist, in letter to Bill Fonferek, Jacksonville District Corps of Engineers, dated May 8, 2000

Response to comment 1. At this time the intention is to update the document periodically, however, no timeframe has been set.

Response to comment 2. ‘Offshore transverse bars to protect and restore seagrasses’ has been added as a beneficial use category.

Response to comment 3. Comment noted.

Response to comment 4. Comment noted.

Response to comment 5. The capacity figure was checked and revised.

Response to comment 6. Comment noted.

Comment from Sarah Watkins dated 5/19/2000

Response. Palm River is included in the list of habitat restoration sites (Table 11).

Comments from Gary Collins, by telephone on 4/12/00

Comment 1. On page 13 a draft Environmental Impact Statement (EIS) is mentioned. A final EIS was prepared and is dated September 1994.

Response to comment 1. This correction has been made.

Comment 2. Table 9. The site capacity of the ODMDS is unknown, not unlimited, as the dispersive nature of the are is not known.

Response to comment 2. All references to 'unlimited' have been changed to 'unknown'.

Comments from Dave Walker, Pinellas County, hand-delivered 4/19/00

Comment response. Data on dredging events has been added to the DMMS as appropriate.

Comment from David Glicksberg

Comment response. Bullfrog Creek has been added as a site to Table 11. The issue about salt content is included.

Comments from Brandt Henningsen, Southwest Florida Water Management District, hand-delivered 4/19/00

Response to comment 1. The entry for Cockroach Bay has been revised to reflect 5 shell pits and 5,000,000 cy.

Response to comment 2. These three Mangrove Bay borrow pits have been added.

Response to comment 3. The inland Sun City Shell Pit has been added as an entry to Table 11.

Letter from Ellie Montague, Sunset Park Area Homeowners Association, to Tracy Leeser, Jacksonville District Corps of Engineers, undated

Comment response. A line has been added to the appropriate tables to include Hillsborough County residential canals. Volumes were not given, however, since not enough information is available to determine a per year shoaling rate. This information could be added when available. The pages of the Residential Canal Dredging Manual included with Ms. Montague's letter have been included as a supplement to the DMMS. Figure 12 has been revised to include the canal locations.

Memorandum for Chief, Plan Formulation Branch, Jacksonville District Corps of Engineers, from Chief, Environmental Branch, dated 02 May 2000

Response to comment a. While minimization of environmental impacts is mentioned in the Tampa Bay Estuary Program's Action Plan as a reason for preparing the long-term management plan, the specific tasks to be accomplished in generating the plan do not include their identification. For this reason, a look at environmental impacts is a recommendation for further study in the 'Conclusions' section of the DMMS.

Response to comment b. Refer to response to comment a.

Response to comment c. Several paragraphs have been added that distinguish between the concept of beneficial uses of dredged material and the three Corps' programs typically used to fund studies and projects that involve beneficial use of dredged material.

Response to comment d. Wording has been added to clarify that this policy is not presently being used in the Tampa Bay area but is available and should be looked into for future use.

Response to comment e. Refer to response to comment c.

Response to comment f. Noted.

Response to comment g. Information added.

Response to comment h. Information added.

Response to comment i. Information added.

Response to comment j. Information added.

Comments from Engineering Division, Jacksonville District, to Planning Division, Coastal/Navigation Section, 5/17/2000, by e-mail from Christopher Brown through Joseph Gurule to Tracy Leeser

Response to comment 1. Noted. As information on the capacities becomes available it can be added to the report.

Response to comment 2. Noted.

Response to comment 3. The information is based on entries in the Jacksonville District dredging history database. The geotechnical information referenced in the comment can be added to the report if it is made available.

Response to comment 4. The possibility of raising the dikes at Cargill has been added to the report.

Response to comment 5. The concepts can be added to the report if information is made available.

Response to comment 6. Placement area capacities are taken directly from information provided by Engineering Division and reflect bulking to whatever extent has been included in the capacity computations.

Response to comment 7. Thin layering is a beneficial use of dredged material recommended by the plan for further study.

Response to comment 8. The numbers have been revised and should all be rounded to the nearest hundred thousand cubic yards.

Response to comment 9. Differences in the stated capacities (on pages 14 and 16) could not be verified. Refer to the response to comment 6.

Section II. Sediment Resuspension Due to Dredging

4-4. Factors Influencing Dredging Turbidity.

a. Occurrence and Extent. The nature, degree, and extent of sediment suspension around a dredging or disposal operation are controlled by many factors, as discussed in WES TR DS-78-13. Chief among these are: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and finally the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing. The relative importance of the different factors may vary significantly from site to site.

b. Hopper Dredge. Resuspension of fine-grained maintenance dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density, turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. In the vicinity of hopper dredges during maintenance operations, a near-bottom turbidity plume of resuspended bottom material may extend 2300 to 2400 ft downcurrent from the dredge. In the immediate vicinity of the dredge, a well-defined, upper plume is generated by the overflow process. Approximately 1000 ft behind the dredge the two plumes merge into a single plume (fig. 4-1). Suspended solid concentrations above ambient may be as high as

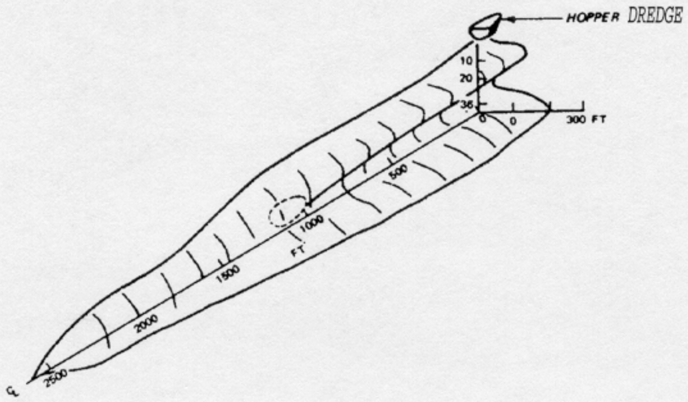

Figure 4-1. Hypothetical suspended solids plume downstream of a hopper dredge operation with overflow in San Francisco Bay (all distances in feet)*

several tens of parts per thousand (grams per litre) near the discharge port and as high as a few parts per thousand near the draghead. Turbidity levels in the near-surface plume appear to decrease exponentially with increasing distance from the dredge due to settling and dispersion, quickly reaching concentrations less than 1 ppt. However, plume concentrations may exceed background levels even at distances in excess of 4000 ft.

c. Bucket or Clamshell Dredge. The turbidity generated by a typical clamshell operation can be traced to sediment resuspension occurring when the bucket impacts on and is pulled off the bottom, turbid water spills out of the bucket or leaks through openings between the jaws, and material is inadvertently spilled during the barge loading operation. There is a great deal of variability in the amount of material resuspended by clamshell dredges due to variations in bucket size, operating conditions, sediment types, and hydrodynamic conditions at the dredging site. Based on limited measurements, it appears that, depending on current velocities, the turbidity plume downstream of a typical clamshell operation may extend approximately 1000 ft at the surface and 1600 ft near the bottom. Maximum concentrations of suspended solids in the surface plume should be less than 0.5 ppt in the immediate vicinity of the operation and decrease rapidly with distance from the operation due to settling and dilution of the material. Average water-column concentrations should generally be less than 0.1 ppt. The near-bottom plume will probably have a higher solids concentration, indicating that resuspension of bottom material near the clamshell impact point is probably the primary source of turbidity in the lower water column. The visible near-surface plume will probably dissipate rapidly within an hour or two after the operation ceases.

d. Cutterhead or Hydraulic Pipeline Dredge. Most of the turbidity generated by a cutterhead dredging operation is usually found in the vicinity of the cutter. The levels of turbidity are directly related to the type and quantity of material cut, but not picked up, by the suction. The ability of the dredge's suction to pick up bottom material determines the amount of cut material that remains on the bottom or suspended in the water column. In addition to the dredging equipment used and its mode of operation, turbidity may be caused by sloughing of material from the sides of vertical cuts; inefficient operational techniques; and the prop wash from the tenders (tugboats) used to move pipeline, anchors, etc., in the shallow water areas outside the channel. Based on limited field data collected under low current conditions, elevated levels of suspended material appear to be localized in the immediate vicinity of the cutter as the dredge swings back and forth across the dredging site. Within 10 ft of the cutter, suspended solids concentrations are highly variable but may be as high as a few tens of parts per thousand; these concentrations decrease exponentially from the cutter to the water surface. Near-bottom suspended solids concentrations may be elevated to levels of a few tenths of a part per thousand at distances of less than 1000 ft from the cutter.

Technical Note DOER-E6
March 1999 (Revised April 2000)

Estimating Dredging Sediment Resuspension Sources

PURPOSE: The technical note herein presents an approach for estimating the suspended-sediment source from cutterhead, hopper, and clamshell dredges. The approach involves modification of an existing method developed from limited field data. These estimates are needed to provide input to a numerical model called SSFATE (Suspended Sediment FATE) that is being developed under the Dredging Operations and Environmental Research (DOER) Program.

BACKGROUND: A need exists for numerical modeling tools to address questions related to environmental windows associated with dredging projects. One such question relates to where and in what quantity suspended sediment from dredging operations moves away from the dredging location. With this information, decision makers would be aided in determining reasonable start and end dates for environmental windows related to fish migratory pathways, sedimentation on sensitive benthic habitats, and other environmental issues. The SSFATE model is being developed under DOER to provide field offices with such a tool. The basic computations are based on a particle-tracking approach with each particle representing a certain amount of sediment mass that is generated at the location of the dredging operation. These particles are then diffused and transported throughout the water body of interest while undergoing settling. Suspended-sediment concentrations at any location at any time in the simulation can be determined from the number of particles occupying some volume surrounding the point of interest.

SSFATE will be a versatile model containing many features; for instance, ambient currents can either be imported from a numerical hydrodynamic model or "painted" using limited field data, and results can be animated over GIS layers depicting sensitive environmental areas. However, regardless of the sophistication and versatility of SSFATE, an integral part of the model will be the estimation of the amount of sediment at the dredging site that is released to the water column, i.e., the sediment-source strength and its vertical distribution. A review of existing literature on field measurements of suspended-sediment concentrations near dredges and proposed approaches for generating sediment sources resulted in the proposed simplified approach discussed in this technical note.

FACTORS INFLUENCING SOURCE STRENGTH: Generally, the major factors influencing the strength of the sediment source at a dredge are the sediment type being dredged, the type of dredge and the manner in which the dredge is operated, and ambient currents. If the sediment is primarily sand, material may be released to the water column, but it quickly settles out. However, if the material is primarily fine grained, it can remain in suspension for an extended time while being subjected to the processes of diffusion, settling, and transport. Different types of dredges typically release different percentages of the dredged volume of sediments into the water column. For example, clamshell dredges release a higher percentage of the dredged volume than generally occurs for a cutterhead dredge. Obviously, the size and manner in which a particular dredge is operated also influence the amount of sediment release. For example, for a hydraulic cutterhead dredge, sediment release increases with higher speed of cutterhead rotation, higher swing speed, and larger cutterhead diameter.

EXISTING APPROACHES FOR ESTIMATING SOURCE STRENGTHS: Two existing approaches for estimating the sediment mass released by a dredge can be found in the literature. The first is based on Nakai's (1978) concept of a turbidity generation unit (TGU), which varies with sediment type and dredge type (Table 1) and has the units of kilograms/cubic meter of dredged sediment. The parameter *d* in Table 1 is the sediment-particle diameter. Pennekamp et al. (1996) list a similar parameter for various types of dredges (Table 2). However, no indication of the sediment type is provided. The basic equation proposed by Nakai (1978) to compute the rate of sediment mass released by a given dredging operation is

Table 1
Turbidity Generation Unit Values from Nakai (1978)

Type of Dredge	Power or Bucket Volume	Dredged Materials			TGU kg/cu m
		$d < 0.74$ mm %	$d < 0.005$ mm %	Classification	
Hydraulic cutterhead	4,000 hp	99.0	40.0	Silty clay	5.3
	4,000 hp	98.5	36.0	Silty clay	22.5
	4,000 hp	99.0	47.5	Clay	36.4
	4,000 hp	31.8	11.4	Sandy loam	1.4
	4,000 hp	69.2	35.4	Clay	45.2
	4,000 hp	74.5	50.5	Sandy loam	12.1
	2,500 hp	94.4	34.5	Silty clay	9.9
	2,000 hp	3.0	3.0	Sand	0.2
	2,000 hp	2.5	1.5	Sand	0.3
	2,000 hp	8.0	2.0	Sand	0.1
Hopper	Two at 2,400 hp each	92.0	20.7	Silty clay loam	7.1
	1,800 hp	83.2	33.4	Silt	25.2
Mechanical grab	8 cu m	58.0	34.6	Silty clay	89.0
	4 cu m	54.8	41.2	Clay	84.2
	3 cu m	45.0	3.5	Silty loam	15.8
	3 cu m	62.0	5.5	Silty loam	11.9
	3 cu m	87.5	6.0	Silty loam	17.1
Mechanical bucket		10.2	1.5	Sand	17.6
		12.7	12.5	Sandy loam	55.8

$$M = (V)(\mathrm{TGU}) / (R74/Ro) \tag{1}$$

where

TGU = turbidity generation unit, kg/cu m

M = mass rate of released sediment, kg/sec

V = volume rate of dredging, cu m/sec

Ro = fraction of dredged sediment that has a critical resuspension velocity smaller than the ambient current velocity

$R74$ = fraction of dredged sediment that has a diameter less than 0.074 mm

Table 2
Turbidity Generation Unit Values from Pennekamp et al. (1996)

Dredge Type	Production cu m/hr	Vertically Averaged Concentration Above Background, mg/ℓ	TGU kg/cu m
Hopper	5,500	400	14
	5,400	150	3
	1,750	15	1-5
	2,170	60	8-22
Open clamshell	90	35	3
Tight clamshell	166	100	19
Open bucket	714	110	18-21

Given the ambient current and the grain-size analysis of the dredged material, $R74$ can be determined from the grain-size analysis and Ro can be determined using typical values for critical resuspension velocity such as those given by Nakai (1978) in Table 3. With the production rate known and a value of TGU selected, the rate of sediment release can then be determined from Equation 1.

Table 3
Critical Resuspension Velocity

Soil Type	Particle Size, mm	Critical Resuspension Velocity, cm/sec
Clay	0.005	0.03
Silt	0.005-0.074	0.03-7.0
Fine sand	0.074-0.42	7.0-15.0
Rough sand	0.42-2.0	15.0-35.0

The second method is described by Averett and Hayes (1995) as the Correlation Method. This method consists of empirical models that have been developed based on observed resuspension rates, sediment characteristics, and dredge-operating parameters at a series of field sites (Vann 1983; Hayes 1987; Hayes, McLellan, and Truitt 1988; McLellan et al. 1989). At the present time, empirical models have been developed only for cutterhead and open-bucket dredges (Collins 1995; Kuo and Hayes 1991).

LIMITATIONS: Both methods are based on limited field data. Because of the highly variable nature of dredging operations, neither of the existing methods for estimating the strength of sediment sources yields highly accurate predictions. Collins (1995) presents a comparison of predicted and observed concentrations using an empirical model for a cutterhead dredge that is based on data collected in Calumet Harbor, Illinois (Figure 1). The two data sets labeled Savannah River are for partial cuts (P.C.) and buried cuts (B.C.) of the cutterhead. The results shown in Figure 1 illustrate that when the correlation method (empirical model) is applied to a dredging activity different from the one where field data were collected and used to determine model coefficients, the results can differ by 1-2 orders of magnitude. Thus, at this time, implementation into SSFATE of the more sophisticated empirical models over the use of the TGU method would not appear to result in better predictions of sediment sources.

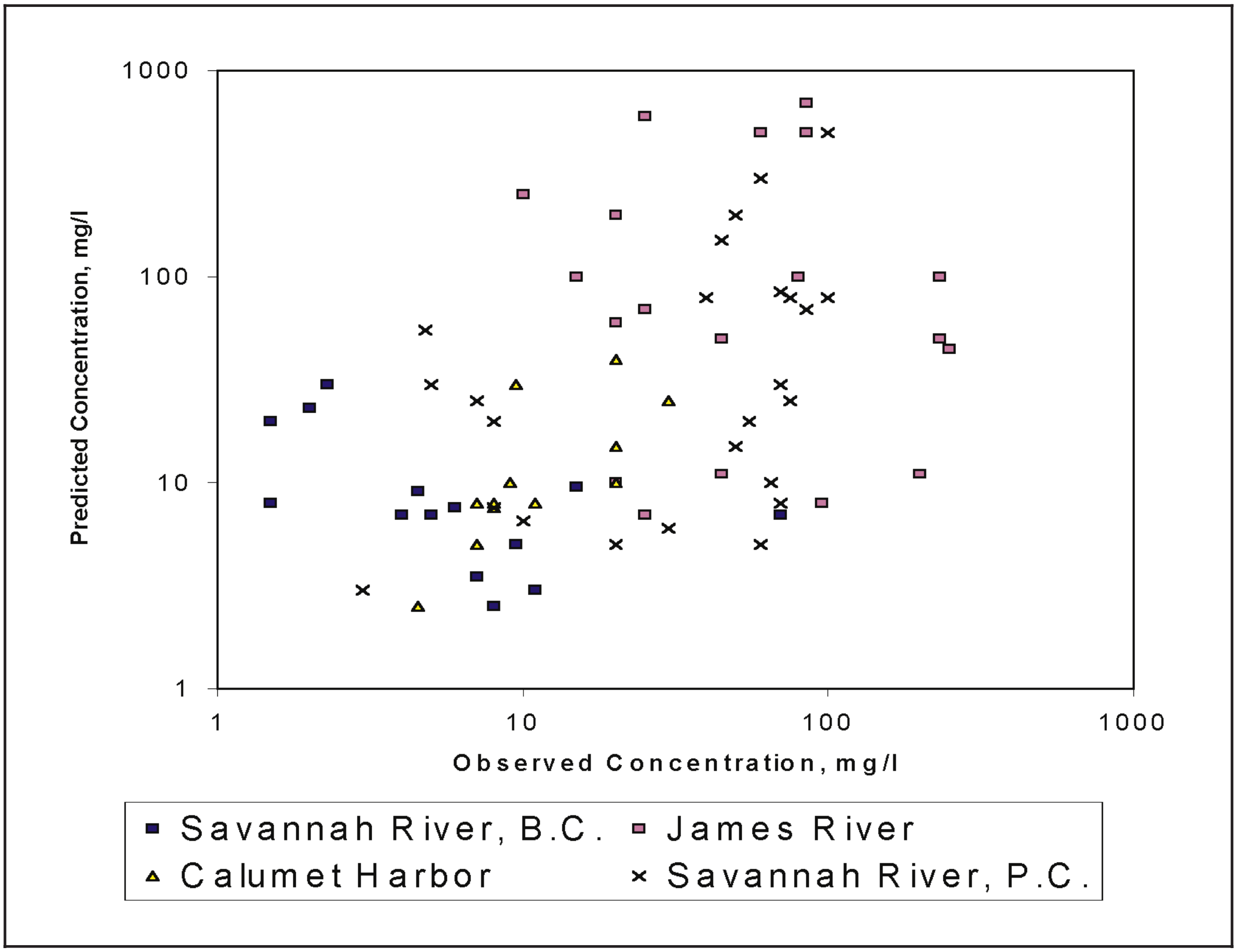

Figure 1. Sediment resuspension predictions for cutterhead dredges (from Collins 1995)

Although predictions using the TGU method must also be viewed with caution, it is the simpler of the two existing approaches. The data required are the dredge type, the grain-size analysis of bed material, the ambient current velocity, and the production rate of the dredge. Of course, the timing of the dredging operation, e.g., the time required for a hopper dredge to carry the dredged material to a disposal site and return to the dredging site, must also be known. The following use of the TGU method is proposed for implementation in SSFATE.

MODIFIED USE OF THE TGU METHOD: As previously noted, the type of dredged material, the type of dredge, and the operation of the dredge, e.g., taking a full cut versus a partial cut with a cutterhead dredge, are major factors influencing the appropriate value of the TGU for use in Equation 1. Much variability is in these factors for a particular dredging operation and thus in the value of the TGU to be selected. An inspection of Tables 1 and 2 reveals that the maximum values of the TGU for cutterhead, hopper, and clarnshell dredges are about 45, 25, and 90 kg/cu m, respectively. The basic problem is how to determine a TGU value for a particular dredging operation involving one of these three dredges. In the proposed approach, such a value is deter-mined by first selecting a typical suspended sediment concentration likely to be produced by the dredging operation.

Figures 2 and 3, which show a range of measured suspended-sediment concentrations near cutterhead and hopper dredges for different soil types, have been constructed from available field data. A good review of these data is provided by Herbich and Brahme (1991). Obviously the operating and ambient conditions under which these data were collected are highly variable. However, one should take into consideration the following general guidelines:

a. For a hydraulic cutterhead dredge, sediment resuspension increases with higher speed of rotation, higher swing speed, larger cutter diameter, and greater depth of cut.

b. For a trailing hydraulic hopper dredge, sediment resuspension increases with increased hopper filling speed and travel speed of dredge.

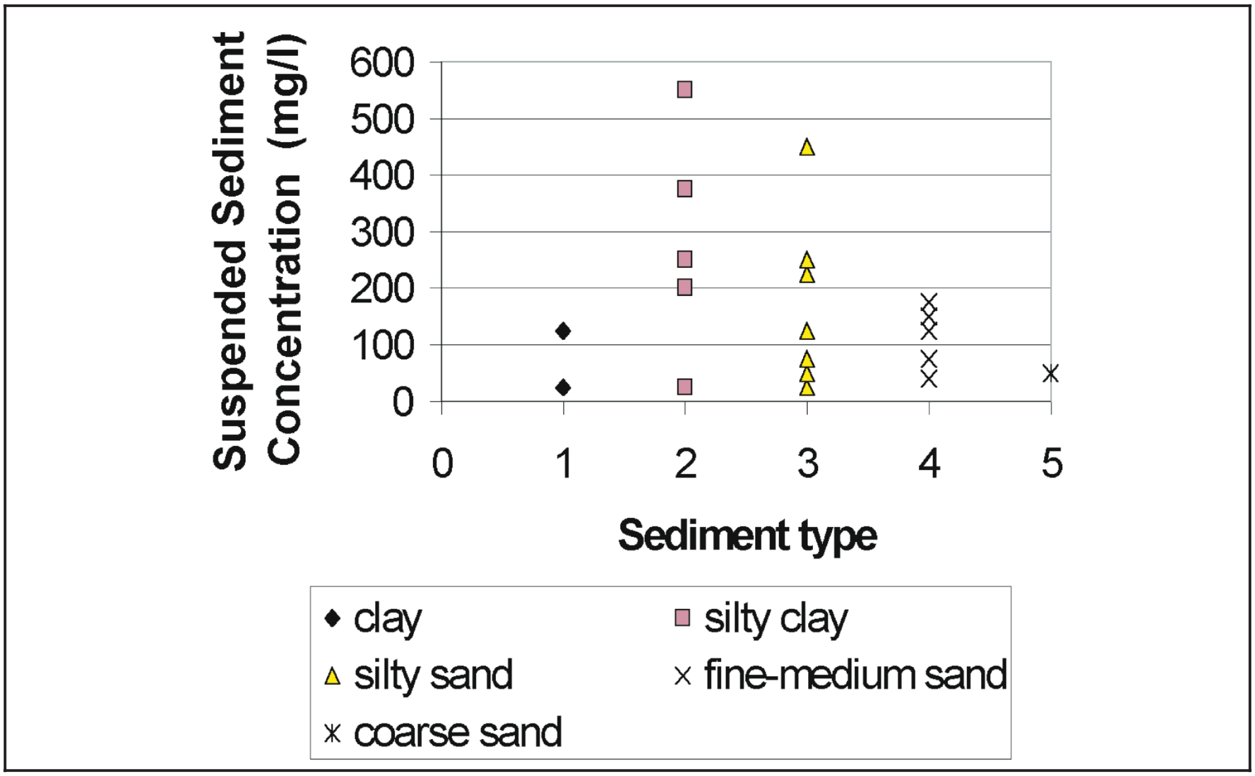

Figure 2. Observed resuspended-sediment concentrations versus soil type for a cutterhead dredge

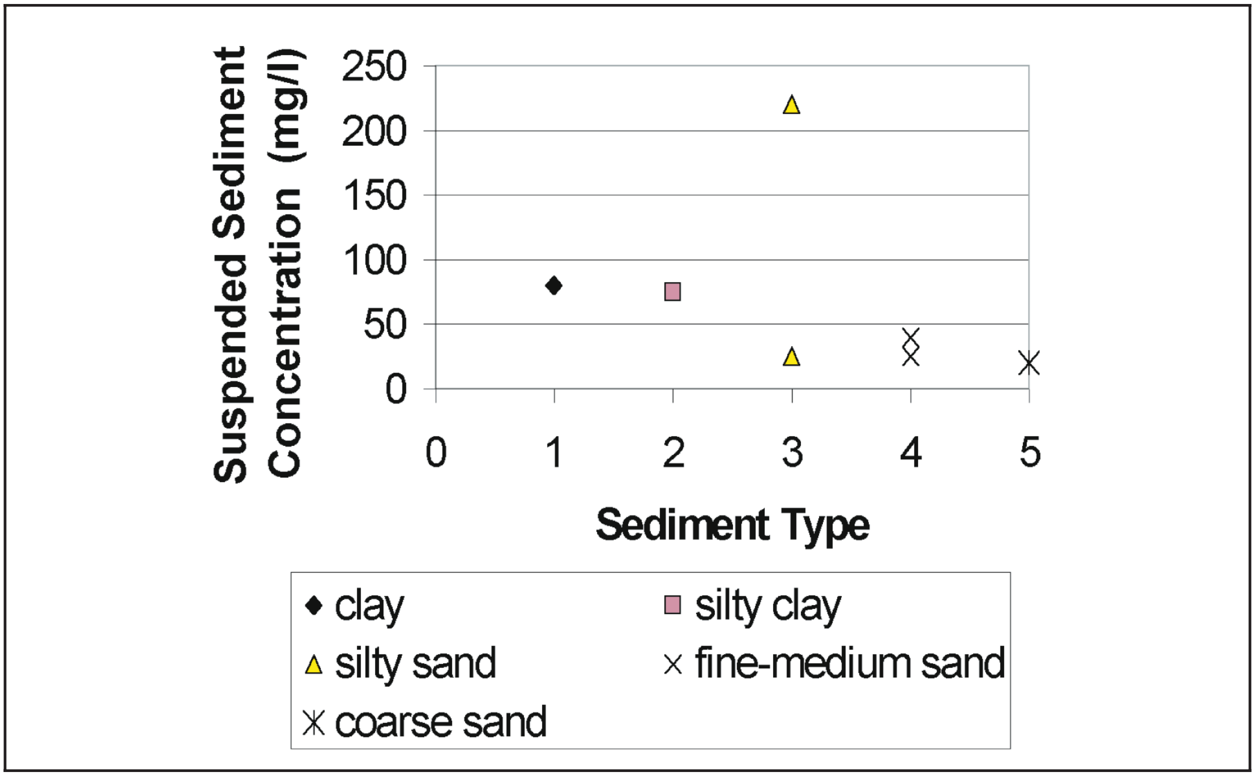

Figure 3. Observed resuspended-sediment concentrations versus soil type for a hopper dredge with no overflow

A typical concentration value can be selected from Figures 2 and 3 for the most predominant (greater than 70 percent) type of sediment being dredged from clay, silty clay (mixtures), silty sand (mixtures), fine-medium sand, and coarse sand.

Figures 2 and 3 are for cutterhead and hopper dredges, respectively. Clamshell dredging operations are slow, and the output rate is low compared with cutterhead and hopper dredges. In view of the limited use of clamshell dredges, few field data are available on the amount of sediment resuspension related to the type of sediment being dredged. However, general guidelines can be proposed. For example, clamshell dredges usually generate high turbidity while dredging fine sediments and stiff clays (McLellan et al. 1989). This turbidity can be distributed throughout the water column because of the action of raising the bucket from the bottom up through the water surface with subsequent disposal in a barge or scow. Based upon the limited data (Herbich and Brahme 1991) available, near-bed sediment concentrations may vary from 200-800 mg/ℓ. The following should be taken into consideration when selecting a value between those two bounds:

a. Loose clay layers will result in higher concentrations, whereas, stiff clays with high density will result in lower suspensions.

b. Greater impact of the bucket on the bottom results in higher sediment release to the water column.

c. Closed buckets generally result in lower suspended-sediment concentrations than those generated with open buckets.

After an appropriate concentration has been selected for the particular sediment type and dredge type, it is proposed that a corresponding value for the TGU be determined from a linear interpolation between a value of zero for no sediment release (zero concentration) and the maximum values shown for either a cutterhead (max TGU = 45 kg/cu m corresponding to max concentration of about 600 mg/ℓ), hopper (max TGU = 25 kg/cu m corresponding to max concentration of about 200 mg/ℓ), or clamshell (max TGU = 90 kg/cu m corresponding to max concentration of about 800 mg/ℓ) dredge. The assumption of a linear variation of the TGU with suspended-sediment concentration seems to be reasonable for concentrations occurring very near the dredge, but no data exist for confirmation. Maybe the variation of the TGU with suspended-sediment concentration has a different functional form, e.g., exponential. However, assuming a linear variation over an exponential variation gives the most conservative value, which is more desirable when predicting suspended-sediment concentrations for use in addressing environmental concerns. Assuming the dredging production rate is known (after the determination of the TGU, *Ro*, and *R*74 values), the rate of sediment mass released can be determined from Equation 1.

Another important part of the sediment source strength term for input to SSFATE is the vertical distribution of the sediment mass computed from Equation 1. Most field data collected near dredging operations are at locations some distance away from the dredge. Therefore, based upon data such as these, accurately assigning vertical distributions at the dredge where the sediment is released is difficult. For preliminary implementation in SSFATE, the sediment resuspended near the bottom by the cutterhead dredge and the hopper dredge is assumed to be released over the bottom 2.5 and 1.5 m of the water column, respectively. The vertical distributions shown in Figures 4 and 5 are assumed.

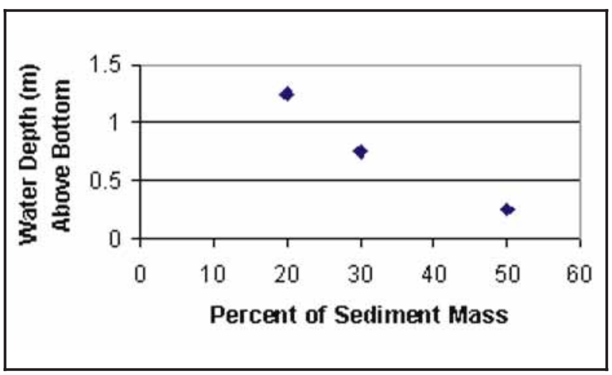

Figure 4. Assumed vertical distribution of bottom sediment source for a hopper dredge

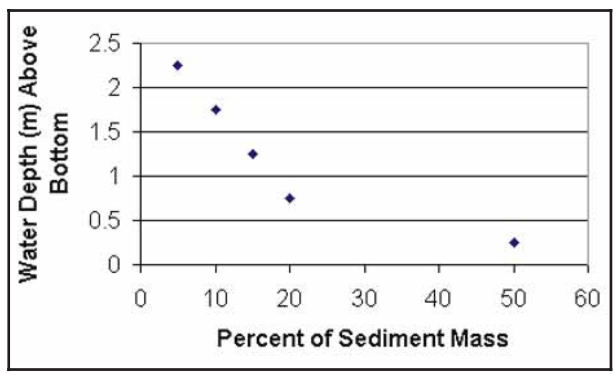

Figure 5. Assumed vertical distribution of bottom sediment source for a cutterhead dredge

Sediment released from a clamshell dredge will occur throughout the entire water column as the bucket is raised to the surface. Thus, the vertical distribution shown in Figure 6 is assumed for implementation in SSFATE. It should be stressed that although these distributions seem reasonable, field data are needed to verify the accuracy of the assumed distributions.

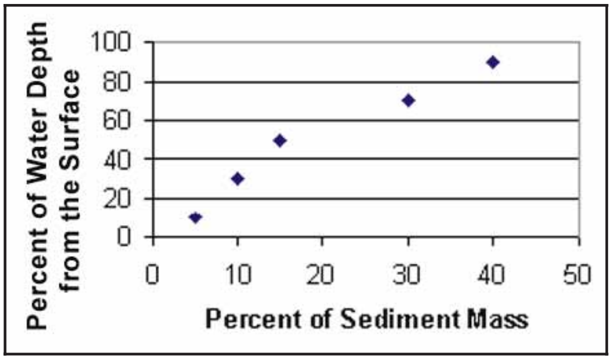

Figure 6. Assumed vertical distribution for sediment source for a clamshell dredge

All of the discussion above has focused on sediment sources that are associated with the removal of material from the bottom. However, when hopper or clamshell dredges operate with overflow from the hoppers or barges, sediment is released at or near the water surface. Typically, overflow dredging only occurs when the sediment being dredged is primarily sandy material. This allows for a higher accumulation of coarse-grained material in the hoppers with the small fine-grained fractions of silt and clay overflowing from the hopper bins into the surface water. Bartos (1977) reported that suspended-sediment concentrations in the upper water column resulting from an overflow operation in San Francisco Bay were several hundred milligrams/liter. The dredged sediment was inorganic clay, and 58 percent had a diameter less than 0.074 mm. Pennekamp et al. (1996) reported a vertically averaged suspended-sediment concentration of about 400 mg/ℓ for a hopper dredge operating with overflow at Rotterdam in The Netherlands. As a conservative estimate for implementation of a near-surface sediment source term for hopper overflow in SSFATE, the sediment mass rate released because of overflow will be computed to be the fraction of fine-grained material in the sediment being dredged times the production rate of the hopper dredge. It will be assumed that the sediment mass released will be uniformly distributed over the upper 2 m of the water column along the horizontal length of the overflow. If the overflow is collected and released below the water surface, the vertical location of the release will be the location of the sediment source in SSFATE.

CONCLUSIONS: An approach for estimating the strength and vertical distribution of sediment sources generated by cutterhead, hopper, and clamshell dredges has been proposed for inclusion in the SSFATE model being developed under DOER. It is believed that based upon available field data, the approach is reasonable and should provide conservative estimates of the amount of sediment released into the water column during dredging activities. As additional field data become available, assumptions such as the linear variation of the TGU with suspended-sediment concentrations and the vertical distributions for the released sediment may need to be modified.

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Johnson, B. H., and Parchure, T. M. (1999). “Estimating dredging sediment resuspension sources,” *DOER Technical Notes Collection* (TN DOER-E6). U.S. Army Engineer Research and Development Center, Vicksburg, MS. *www.wes.army.mil/el/dots/doer*

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Dredged Material Characterization Tests for Beneficial Use Suitability

PURPOSE: The nature, magnitude, and distribution of contaminants in dredged material vary within and between sites, making consideration of the potential beneficial uses of dredged material more difficult. This technical note provides guidance on the nature and types of physical, engineering, chemical, and biological characterization tests appropriate for determining the potential for beneficial uses of dredged material in aquatic, wetland, and upland environments.

BACKGROUND: The U.S. Army Corps of Engineers (USACE) has the responsibility for maintaining and improving navigation in waters of the United States. More than 300 million cubic meters of sediment are dredged annually to accomplish this task. Most of the dredged material (approximately 90 percent) is considered uncontaminated. However, some waterways are located near areas that are highly industrialized or in urban settings, and the sediments have been contaminated by point and nonpoint sources of metals and anthropogenic organic chemicals [e.g., petroleum aromatic hydrocarbons (PAHs) and/or polychlorinated biphenyls (PCBs)]. Agricultural practices have also contributed to sediment contamination (pesticides, herbicides, fertilizers) in rural areas. Contaminated sediments, unacceptable for open-water placement, are usually placed in confined disposal facilities (CDFs) or confined placement facilities (CPFs). Because many existing CPFs are filled to capacity, finding additional suitable placement sites for dredged material is a growing concern. The USACE/U.S. Environmental Protection Agency (USEPA) technical framework describes the evaluation procedures established for the determination of beneficial uses of dredged material (USACE/USEPA 1992). A beneficial use component is included in that framework and is expanded in this technical note to give additional guidance on its implementation. Alternatives must be developed that can provide beneficial uses for both the contaminated and uncontaminated dredged material in CPFs so that these materials can be removed and used, resulting in the creation of additional CPF storage capacity for future dredging activities.

INTRODUCTION: Dredged material, like soil, is a complex matrix with many dynamic interacting components that can affect more than one property. Adequate assessments of the geotechnical, engineering, chemical, and biological properties must be considered in determining the potential beneficial uses of a dredged material. The properties of a dredged material must be matched to a particular beneficial use. Conditioning dredged material may also be required to produce a material that can perform a beneficial function. A number of physical, engineering, chemical, and biological tests are available to characterize and aid in making decisions about the potential beneficial uses of the dredged material. Appropriate characterization tests are listed in Tables 1-3 of this technical note. Even though most of these analyses were initially designed for soils, they can be applied to dredged material because of its soil-like nature. The terms “soil” and “dredged material” will be used interchangeably throughout this technical note.

Characterization of the dredged material is initiated by an evaluation of its physical properties including (a) grain-size distribution, (b) particle shape, (c) texture, (d) water content, (e) permeability,

Table 1
Appropriate Characterization Tests for Determining Physical and Engineering Properties of Dredged Material to Evaluate Its Suitability for Beneficial Uses

Physical Analysis	Source
1. Grain Size	
Standard Sieve Test	ASTM D422-63; COE V; DOD 2-III, 2-V, 2-VI; CSSS 47.4
Hydrometer Test	ASTM D422-63; CSSS 47.3; COE V
Pipette Test	CSSS 47.2
2. Particle Shape/Texture	ASTM D2488, D4791-95, and D3398-93
3. Water Content/% Moisture	ASTM D2216-92; COE I-1; DOD 2-VII
4. Permeability	ASA: 41-3 and 41-4; ASTM D2434-68
5. Atterberg Limits (Plasticity)	ASTM D4318-9 5; COE III; DOD 2-VIII
6. Organic Content/Organic Matter	ASTM D2487-93
Engineering Properties	**Source**
7. Compaction Tests	
Proctors	COE VI
Standard Compaction Test	ASTM D698-91
Modified Compaction Test	ASTM D1557-91
15 Blow Compaction Test	ASTM D5080-93
California Bearing Ratio	DOD 2-IX
8. Consolidation Tests	COE VIII; ASTM D2435-90
9. Shear Strength	
UU (unconsolidated, undrained)	COE X-18
CU (consolidated, undrained)	COE X-29
CD (consolidated, drained)	COE IX-38

Notes:
ASTM = American Society for Testing and Materials (ASTM 1996).
ASA = American Society of Agronomy/Soil Science Society of America. Method of Soil Analysis, Part-1, 1965.
COE = EM 1110-2-1906 (Headquarters, U.S. Army Corps of Engineers 1986).
CSSS = Canadian Society of Soil Science (Carter 1993).
DOD = U.S. Department of the Army, Navy, and Air Force 1987.

(f) plasticity, and (g) organic content. The engineering properties are used to determine the compactability, consolidation, and shear strength of the dredged material. An assessment of chemical properties can indicate the actions required to (a) obtain the desired pH or salinity, (b) determine a liming requirement to enhance buffering capacity or nutrient availability for plant growth, (c) improve texture, and (d) determine if inorganic (e.g., metals) or organic contaminants (e.g., PAHs, PCBs) are present. Finally, the biological properties must be assessed to (a) evaluate the bioavailability of contaminants to plants and animals, (b) determine the potential for adverse environmental impacts, and (c) determine if control measures or restrictions are required to prevent adverse environmental impacts.

Table 2
Appropriate Characterization Tests for Chemical Properties of Dredged Material to Determine Suitability for Beneficial Uses

Analysis	Source
10. pH	ASA 1996 :Ch 16; CSSS: 16.2.1
11. Calcium Carbonate Equivalents	ASA 1996:Ch 16; CSSS 14.2 and 44.6
12. Cation Exchange Capacity	ASA 1996: Ch 40; CSSS 19.4
13. Salinity	ASA 1996: Ch 14; CSSS:18.2.2
14. Sodium	ASA 1996: Ch 19
15. Chloride	ASA 1996: Ch 31
16. Sodium Adsorption Ratio (SAR)	CSSS: 18.4.3
17. Electrical Conductivity	ASA 1996: Ch 14
18. Total Organic Carbon	ASTM D2974; D2974-87; ASA 1982: 29-4.2; CSSS 44.3
19. Carbon:Nitrogen Ratio	Analyses 19, 23, and 25 in this table
20. Total Kjeldahl Nitrogen	EPA-CRL-468
21. Ammonium Nitrogen	EPA-CRL-324
22. Nitrate-nitrogen	EPA-SW846-9200
23. Nitrite-nitrogen	EPA-SW846-9200
24. Total Phosphorus	EPA-CRL-435
25. Orthophosphorus	EPA-CRL-435
26 Potassium	ASA 1996: Ch 19
27. Sulfur	ASA 1996: Ch 33
28. Diethylene Triamine Pentaacetic Acid (DTPA) Metals	ASA 1982: 19-3.3; CSSS:1.3; Lee, Folsom, and Bates 1983
29. Total Metals *	EPA-SW846-200.9; ASA 1996: Ch 18-30
30. Pesticides (chlorinated)	EPA-SW846-8080
31. Polynuclear Aromatic Hydrocarbons (PAHs)	EPA- SW846-8270
32. Polychlorinated Biphenyls (PCBs) Congeners	EPA-CRL-8081
33. Dioxins	EPA-SW846-8290 and 1630
34. Leachate Quality Test	Myers and Brannon 1988
35. Surface Runoff Quality	Skogerboe et al. 1987

Notes: * Metals = arsenic, cadmium, chromium, copper, lead, mercury, silver, nickel, and zinc; Use EPA 1986 Method 245.6 for mercury determinations.
Methods:
ASA = American Society of Agronomy/Soil Science Society of America (Page, Miller, and Keeney 1982 and 1996).
CSSS = Canadian Society of Soil Science (Carter 1993).
ASTM = American Society for Testing and Materials (ASTM 1996).
EPA = USEPA (1986).

Table 3
Appropriate Tests for Biological Properties of Dredged Material to Determine Suitability for Beneficial Uses

Analysis	Methods
36. Manufactured Soil Test	Sturgis et al. (1999)
37. Plant Bioassay	Folsom, Lee, and Preston 1981
38. Animal Bioassay	ASTM 1998, Standard Guide E 1676-97
39. Elutriate Bioassay	EPA 1991 (Method: 11.1.4) (USACE/USEPA 1991)
40. Pathogens (coliforms)	Standard Methods: 9221 E (Greensberg et al. 1992)

CHARACTERIZATION TESTS USEFUL IN DETERMINING PHYSICAL PROPERTIES

Grain Size, Particle Shape, and Texture. Grain size and particle shape are useful in determining the stability, resistance to shear, permeability, compressibility, and compactability of the dredged material. Grain size can be determined mechanically with sieves (direct) or indirectly with the hydrometer or pipette methods. Sieving is not practical for silt- or clay-sized particles since they tend to clog the screen. When conducting grain-size determinations on silt- or clay-sized particles, sedimentation in water (hydrometer or pipette methods) is preferred. Grain-size distribution and particle shape significantly impact on the weight-bearing capacity of soil or dredged material. Angular particles tend to interlock, forming a stable dense mass capable of bearing more weight than rounded particles, which tend to slide or roll past each other. Dense soils have greater weight-bearing capacities than loose soils. The strain required to reach failure is approximately twice as large for angular-shaped particles as that required to reach failure for spherical particles.

The texture of a soil is its appearance or “feel” and depends on the relative size and shape of the particles, as well as the range or distribution of those sizes. Soil texture is affected by the mineral content, organic matter, soil aggregates, and moisture present in the soil. Soil texture contributes to the water-storage capacity, water-infiltration rates, aeration, fertility, and ease of tilling, as well as compressibility. The texture of dredged material can limit its beneficial uses. For example, predominantly sandy dredged material can be used as a fill material or in dike construction, but might not be suitable for vegetation establishment because of its low nutrient content and water-holding capacity.

Water Content and Permeability. Water content and permeability are interrelated and have a significant influence on the suitability of a dredged material for use as a fill, subgrade, or foundation material. Water content (w) is one of the most important factors affecting the properties and behavior of dredged material. Water content is the ratio of the weight of water to the dry weight of the solids in a mass of dredged material, expressed as a percentage. Soil must be compacted to obtain the required strength and density while the water content is maintained at the optimum level during construction projects (e.g., embankments, highway subgrades). The behavior of fine-grained soils, like silt or clay, is influenced by the water content.

Permeability is one of the factors that determine shear strength and is a measure of water or air movement through the dredged material. Permeability is determined by mineralogical composition, particle size and distribution, void ratio, degree of saturation, and pore fluid characteristics. Very fine-grained materials (clayey) generally have low permeability rates to water, and this is a desirable feature when dredged material is used as fill or foundation material in landfills. However, if the material is to be used for revegetation projects, coarse-grained material would need to be added to clayey material to enhance aeration and root penetration.

Atterberg Limits (Plasticity Tests). Plasticity tests are conducted on dredged material that is finer than 0.425 mm to determine the range of water content in which plasticity is exhibited. The types and amounts of clay particles present and water content, as well as the physicochemical interactions of clay particles, determine the plastic behavior of a dredged material. The Atterberg Limits consist of the liquid limit (LL) and plastic limit (PL) and can be used to assess the amount of dewatering needed before a dredged material can be handled and processed. The Atterberg

Limits, either individually or with other soil properties, can be correlated to other properties such as compactability, compressibility, shear strength, or permeability. The water content above which a dredged material is in a semiliquid state is its LL. The water content that is the lower limit of the plastic state and the upper limit of the semisolid state is the PL. If the water content of the dredged material is below its PL, it becomes brittle and breaks into fragments when remolding is attempted.

The plasticity index (PI), liquidity index (LI), and activity index (AI) are derived from the PL and LL. The PI is the difference between the LL and PL. Materials with a large PI have more plasticity than those with a smaller PI. The PI is directly proportional to the clay content. The LI is some dimensionless number that indicates the ratio of the water content w of a cohesive soil minus the ratio of its PL to the PI (LI = w - PL/PI), and it normalizes the water content relative to the plasticity index. The following relationships are noted for remolded soil: (a) when the LI = 0, the soil is at its PL water content and is stiff, (b) when LI = 1.00, the soil is at the LL water content and is soft, and (c) when LI > 1.00, the soil is liquidlike (slurry). The AI is the ratio of the PI to the percentage of clay and is useful in identifying the type of clay minerals present in the dredged material: AI = 0.3-0.5 for kaolinite, AI = 0.5-1.0 for illite, and AI = 1-7 for montmorillonite. Each clay mineral has a unique behavior. Knowledge of the clay mineral type aids in determining the behavior and water-holding capacity of the dredged material.

Organic Content/Organic Matter. The organic content in a soil can contribute to high plasticity, high shrinkage, high compressibility, permeability, or low strength. Soils with significant amounts of organic matter generally have lower shear strength and higher compressibility than those composed mainly of inorganic minerals. An organic soil is one where the LL of the oven-dried soil is <75 percent of the LL of the soil before it was dried. While a certain amount of organic material can be desirable (e.g., enhanced buffering capacity, immobilizing contaminants), it can make characterization of dredged material more difficult since there are many forms of organic materials, and, depending on the origin, each has distinctive attributes.

CHARACTERIZATION TESTS USEFUL IN DETERMINING ENGINEERING PROPERTIES

Compaction Tests. One of the basic and least expensive construction procedures used for soil stabilization is compaction. Compaction mechanically increases the amount of solids per unit volume of soil. It improves the engineering properties of foundation material so that the required shear strength, structure, or void ratio are obtained, while decreasing the shrinkage, permeability, and compressibility. Compaction is often required when building subgrades or bases for airport pavements, roads, embankments, earthfill dams, or similar structures. The Proctor and California Bearing Ratio (CBR) are two commonly used compaction tests. Three basic Proctor (compaction) tests are used depending on the amount of compaction anticipated: the standard, the modified, and the 15-blow compaction tests. The standard compaction test is generally used in routine foundation and embankment design to simulate field compaction; the modified compaction test is used when a higher level of compaction is desired; and the 15-blow compaction test is used when lower levels of compaction are required. These tests aid in determining the percent compaction and water content necessary to obtain the desired engineering properties for construction. Before a dredged material is used as a fill for road bases, foundation pads, or embankments, it is vital that the amount of compaction needed to obtain the required shear strength, compressibility, and permeability is determined.

The CBR is used to determine resistance to penetration of a material (subgrades or bases) before its ultimate shearing modulus is reached. Its primary use has been in the design of flexible pavements for airfields located in areas where frost action is not a controlling factor. Since moisture content affects the results, tests must be conducted using a moisture content that approximates the moisture content anticipated at the site where the pavement is to be constructed. Values obtained usually range from 3 to 80 depending on the type of material tested.

Consolidation Tests. Consolidation tests are needed to estimate the readjustment or plastic deformation likely to occur when soil is subjected to increasing pressures or loads and to determine the compressibility of the dredged material (compressibility index C_c). It is a rate process based on the time required for pore fluid, either water or air, to flow out of soil pores (void-ratio reduction). The rate of consolidation is dependent on (a) the degree of saturation, (b) the coefficient of soil permeability, (c) the nature of pore fluid (air or water), and (d) the distance the pore fluid has to travel for equilibrium to occur. The amount of consolidation or settlement likely to occur must be determined before dredged material is used as a base or subgrade.

Shear Strength. The behavior of dredged material under a load is a measure of its shear strength. Before a dredged material can be used for construction purposes, its shear strength must be determined (e.g., weight-bearing capacity and stability of earthen slopes are directly related to shear strength). Three tests are generally used to determine shear strength: (a) the unconsolidated, undrained (UU) test, (b) the consolidated, undrained (CU) test, and (c) the consolidated, drained (CD) test. The methods and appropriate characterization tests for determination of geotechnical and engineering properties of dredged material are listed in Table 1.

CHARACTERIZATION TESTS USEFUL IN DETERMINING CHEMICAL PROPERTIES

pH. The chemical properties of dredged material are interrelated, but pH is one of the most useful and informative parameters in characterizing those properties. It is a measure of the concentration and activity of ionized hydrogen (H^+) in the dredged material/soil solution. The pH affects the chemical properties of dredged material, including (a) surface charge of organic matter, clay, or mineral particles, (b) solubility, mobility, and toxicity of contaminants (e.g., metals, organics), (c) relative binding of positively charged ions to the cation exchange sites, (d) calcium carbonate equivalents (liming requirements), and (e) nutrient availability. pH values are “beacons” that point to potential corrective actions: pH < 4.0 is indicative of the presence of free acids (e.g., sulfates or nitrates); pH < 5.5 indicates that toxic amounts of exchangeable aluminum, iron, or manganese may be present; pH values between 7.8 and 8.2 are indicative of large accumulations of bicarbonate ions. pH is a useful tool for determining the kinds of analyses or corrective action(s) needed before dredged material can be used in beneficial ways.

Calcium Carbonate Equivalent. The calcium carbonate equivalents (lime requirements) and pH are closely related parameters. The calcium carbonate equivalent is an indicator of the amount of lime required to neutralize any acidity present in order to maintain the desired pH. If large concentrations of sulfides are present in the dredged material, heavy lime application may be required to neutralize the acidity produced from the oxidation of sulfides to sulfates. The need for lime can usually be determined by the calcium carbonate equivalent, which is expressed in terms of lime ($CaCO_3$/100 g of dredged material). Agricultural lime is the most commonly used basic material because of its low cost and growth-enhancing qualities. Liming can reduce the bioavailability and toxicity often present in acidic soil when aluminum (Al), manganese (Mn), and other metals (zinc (Zn), copper (Cu), or nickel (Ni)) are present at elevated concentrations.

Cation Exchange Capacity (CEC). Cation exchange reactions in a soil are important because they alter soil physical properties, cause/correct acidity and basicity, affect soil fertility, and can purify or alter percolating waters. Electrostatic charges are inherent on soil particles. Some charges are permanent, while others are pH dependent. Exchangeable cations (positively charged ions) are attracted to the negatively charged surfaces and replace the cations on the particle surfaces. As the CEC increases, the amount of adsorbed cations increases. The CEC is pH dependent and directly proportional to the clay concentration, organic matter content, and particle-size distribution.

Salinity. Salinity is a measure of the concentration of soluble salts. Cations (sodium, potassium, calcium, and magnesium) and anions (sulfates and chlorides) are the predominant solutes that contribute to salinity. Salt accumulations in soil can adversely affect its structure (decreases the cohesiveness of particles), inhibit water and air movement, increase the osmotic potential, decrease the available nutrient content, induce toxicity to specific ions, and prevent the growth of many plants (except halophytes). Salinity is conventionally measured on aqueous extracts of a saturated paste. A saturated paste is prepared by adding just enough water to saturate the soil sample until it glistens and flows slightly when the container is tipped. The recommended ratio of soil:water in the paste is the smallest amount that can be easily removed with vacuum or pressure since this amount readily correlates to water content under field conditions. Other extraction ratios (1:1, 1:5, etc.) can be used but are not readily correlated to water content under field conditions. The method utilized should be based on the specific conditions and needs of the project. Vegetative responses to salt-affected soil are also influenced by the ratio of calcium to the other ions in solution. Yields are generally reduced when the ratio of calcium to other ions is less than 0.10 (the critical calcium ratio).

Sodium Adsorption Ratio (SAR). The SAR indicates the tendency for sodium to adsorb to the cation exchange sites at greater concentration than calcium or magnesium and is an index of the relative sodium content of the soil solution expressed in mmol l^{-1}. More specifically, it is the ratio of sodium ions to the sum of the calcium and magnesium ions ($SAR = (Na^+)/(Ca^{2+} + Mg^{2+})^{0.5}$). Dredged materials with SAR values in the range of 10-13 or higher are generally considered sodic. The concentration of exchangeable sodium in a sodic soil is so high that the soil becomes dispersed and impermeable to water as the pores become clogged with dispersed or dislodged clay particles. Plant growth is adversely affected when sodium occupies a high proportion of the exchange sites because pH can become basic (8.5 to 10.5), and the soil aggregates required for plant growth disintegrate and disperse.

Electrical Conductivity. Electrical conductivity is another measure of the soluble salts (ionic strength) present in the dredged material/soil and is reported in decisiemens per meter (dS m^{-1}). It increases as the concentration of dissolved salts increases (electrical conductivity (dS m^{-1}) $\times$ 10 = mmol L^{-1} of soluble salts (total cations or anions)). The electrical conductivity is usually measured on a saturated paste extract of the dredged material using electrodes, and the value obtained can be related to the actual soluble salt concentration in the dredged material. Generally, plants respond in the following ways to electrical conductivity: <2, negligible; 2-4, slight reduction in yield of sensitive plants; 4-8, reduced yield in most plants; 8-16, satisfactory yield only in salt-tolerant plants; and >16, satisfactory yield only in plants that are extremely salt-tolerant. The information from salinity and electrical conductivity tests are somewhat similar but used for different purposes by different individuals. Either test can be used to meet the specific needs of the user.

Total Organic Carbon. Soil organic carbon is the fraction of total carbon that is derived from the organic matter in the soil and consists of plant, animal, and microbial residues (fresh and in all stages of decomposition) as well as the humus. Organic matter normally contains many of the nutrients required for plant growth: 95 percent of the dredged material nitrogen, 50 percent of the phosphorus, and when iron sulfides are not present, ≥80 percent of the sulfur. Organic carbon comprises 48-58 percent of the organic matter content of soil. Conversion factors can be used to obtain an estimate of the organic carbon (organic matter × 1.724 (surface soils) or 2.0 (subsurface soils)).

Total Phosphorus/Orthophosphorus. Phosphorus is an essential nutrient for all forms of life. Plants take it up primarily as the orthophosphate ion ($H_2PO_4^-$) from fertilizers or as it is released from organic matter decomposition. The other ionic forms, monophosphate ions (HPO_4^{2-}) or phosphate ions (PO_4^{3-}), are less available for plant uptake. Most metal phosphates are insoluble under neutral and alkaline conditions (except those of alkali metals) but are soluble under acidic conditions. The orthophosphate ion ($H_2PO_4^-$) is generally the soluble form of phosphorus occurring in dredged material/soils, but it can react quite rapidly with soluble iron or aluminum to form insoluble phosphates. pH affects phosphorus availability through its effect(s) on microbial growth and the solubility of calcium, iron, or aluminum. The optimum pH for phosphorus bioavailability to plants is 6.5 in mineral soils and 5.5 in organic soils.

Carbon:Nitrogen (C:N) Ratio. The C:N ratios present in dredged material/soil help determine if conditions are optimal for the growth of soil microbes, as well as plants. Bacteria require four pounds of carbon for every pound of nitrogen (4:1) in order to have optimum growth and metabolism (decomposition/recycling of organic matter). Decompositional activities of microbes can be increased by the addition of more nitrogen. Materials with a wide C:N ratio are low in nitrogen content. Bacteria are more abundant and in closer contact with soil particles than the root surfaces of plants. Therefore, if nitrogen is low, bacteria will use up available supplies before it ever becomes accessible to plant roots, resulting in nitrogen deficiency in plants.

Nitrogen. Nitrogen is the nutrient most likely to be limiting for plant growth. It can be lost from soil/dredged material by leaching, volatilization, denitrification, or immobilization. Ammonium nitrate is often used as a fertilizer because of its low cost. Half of its nitrogen content is in the form of ammonium and half is nitrate. The nitrate ions are quite mobile and bioavailable to plants when ammonium nitrate is added to soil. The ammonium cations tend to adsorb to the cation exchange sites and are bioavailable to plants but less mobile than the nitrate.

Potassium. The availability of potassium in the dredged material needs to be determined if vegetation establishment is the potential beneficial use. Most of the potassium requirements of vegetation is supplied by the exchangeable potassium ions in the soil CEC and from soluble potassium ions in the soil solution. If the CEC of the dredged material is low, as in sandy material, it may need to be amended with potassium fertilizers. Since potassium forms a positive ion, it has limited mobility through the soil and should be placed where it is most accessible for growing roots.

Sulfur. Sulfur is generally taken up by plants in the form of sulfates and is often supplied from the decomposition of organic matter or soluble minerals. Although sulfur-deficient soils are not very common, sulfur is a necessary constituent of three essential amino acids. The amount of sulfur required is dependent on the target vegetation.

Contaminants. The presence of contaminants (metals, pesticides, PAHs, PCBs) in dredged material is a concern. These substances generally sorb to the sediment particulates (i.e., organic matter, clay particles, aggregates, hydrous oxides) and settle out in the anaerobic (reduced) alkaline environment existing on the bottom of waterways. The solubility, mobility, and bioavailability of these contaminants are generally reduced under anaerobic alkaline conditions. However, the dredged material can become oxidized and more acidic during dredging and placement into CPFs. The potential then exists for sorbed contaminants to become solubilized, mobile, and bioavailable. Analyses need to be conducted to determine if contaminants have become solubilized and bioavailable (i.e., DTPA, biological screening tests). Then the appropriate corrective measures can be taken to prevent adverse environmental impacts.

Surface Runoff Quality and Leachate Quality Tests. The potential exists for solubilized contaminants in the dredged material to migrate offsite during and after placement into upland sites. As the dredged material dries out and becomes oxidized, the potential exists for contaminants to become soluble, mobile, and bioavailable. During precipitation events, water percolates through the dredged material, and contaminants can migrate in the runoff and be carried into surface-receiving waters. Chemical analyses are conducted on surface runoff waters when there is concern about contaminants that have established water quality criteria (WQC), and/or a biological evaluation is conducted for those contaminants that have no established WQC. The leachate quality test is used when the potential exists for contaminants to enter surface-receiving waters or groundwaters. The leachate quality test evaluates the potential for adverse impacts from (a) seepage from dikes into a receiving water body, (b) subsurface drainage into an aquifer used for drinking water, and (c) seepage into nonpotable subsurface water. The results of both tests should be compared with the quality of an appropriate reference surface water or groundwater source. Methods and appropriate characterization tests for determining chemical properties are listed in Table 2.

CHARACTERIZATION TESTS USEFUL IN DETERMINING BIOLOGICAL PROPERTIES: Biological tests are conducted to assess the potential for adverse effects to occur in biological indicator organisms as a result of exposure to contaminants in the dredged material. These tests integrate existing conditions in the dredged material and evaluate the bioavailability of contaminants in the dredged material. The chemical species (form) of contaminants determine their bioavailability and potential for uptake, bioaccumulation, and toxicity once they reach their site of action in living organisms, not simply their presence in dredged material. Elutriate bioassays are conducted to assess/evaluate the bioavailability and potential toxicity of contaminants that are either adsorbed on particle surfaces (can be easily washed off or eluted) or solubilized in pore waters. The manufactured soil test and plant/animal bioassay are designed to determine if adverse (toxicity) effects occur in test organisms as a result of exposure to contaminants in the dredged material. The responses of dicot and monocot plant species are evaluated during the plant bioassay, and the optimum combination of dredged material, carbon source, and organic waste amendments is assessed using the manufactured soil test. Test conditions can be controlled or varied to simulate those expected to be encountered under field situations (upland or wetland) so that the data obtained can be used to make realistic predictions and evaluations. The pathogen (coliform) analysis is used to detect the presence of disease-causing bacteria, usually of fecal origin. Table 3 lists methods and appropriate characterization tests for determining biological properties.

BENEFICIAL USES OF DREDGED MATERIAL: There are many potential beneficial uses of processed dredged material in upland, wetland, or aquatic environments (see Table 4). The properties, as well as the types and bioavailability of contaminants, will determine the beneficial uses of a dredged material and the amount of processing needed to reduce adverse environmental impacts. In addition, waste materials such as fly ash, alkaline wastes, and spent lime can be added to dredged material to engineer a soil product that can meet specifications required for a particular beneficial use. Examples are impermeable caps for landfills, superfund sites, and brownfields.

Table 4
Potential Beneficial Uses of Dredged Material

Upland Environments

Fill, subgrade construction:
    Highway/road/airport landing strip
    Asphalt, concrete, bricks
    Washouts/barren areas along highways
    Mine shaft fill
    Covers for landfills, brownfield, superfund and mining sites
    Earthen slopes
    Biomechanical erosion control structures
    Cemeteries
Manufactured soil products:
    Landscaping
    Bagged soil
    Recreational areas/parks/campgrounds
    Silviculture, horticulture, agriculture
    Covers for landfills, brownfield, superfund and mining sites

Wetland Environments
Constructed wetlands for water quality improvement Creation of mitigation, wildlife habitat wetlands, marshes, etc. Erosion control, bank stabilization Geotextile tube fill, berm construction Biofilters for landfill leachate/seepage Biofilters for acid mine drainage
Aquatic Environments

Capping open-water placement sites
Beach and shoreline nourishment
Solid structures for fish habitat
 	
Geotextile tube fill
 	
Creation of:
    Islands
    Tidal flats
    Sea grass meadows
    Oyster beds
    Fishing reefs
    Clam flats
Dike or berm construction

While habitats will develop from placement of dredged material into disposal sites, the enhancement and development of high-quality habitats require the utilization of sound management strategies.

Dredged material is an under utilized resource that can be used in a beneficial manner once appropriate physical, engineering, chemical, or biological properties are determined. Over 2,000 man-made islands have been created in the Great Lakes and coastal and riverine areas by the U.S. Army Corps of Engineers. These islands, along with additional ones, can provide nesting areas, protection from terrestrial predators, and the seclusion from humans needed by migratory or colonial nesting waterbirds and threatened or endangered species (e.g., pelicans, spoonbills, gulls, herons, terns). Additional beneficial uses in aquatic environments include habitat creation (reefs, tidal flats, sea grass meadows), erosion control (underwater berms made of geotextile tubes filled with dredged material, beach and shoreline nourishment), and construction (dikes). Dredged material can be used to augment decreasing wetland resources including freshwater and saltwater marshes, biofilters for landfill leachate, constructed wetlands for wastewater treatment, or fill for sloughs in riverine areas or denuded reservoir banks. There are a vast number of beneficial uses in upland areas including construction of roads or airport runways, landscaping (manufactured soil products), parks and recreational area development, cemetery development, and others. All products made from dredged material will have to meet the performance specifications established for existing material and will have to be cost competitive, available in a timely manner, and tested for performance.

A phased approach to testing should be employed in determining suitability for beneficial uses. It may not be necessary to conduct all of the characterization tests. An evaluation procedure for beneficial uses of dredged material is shown in Flowcharts 3-1 and 3-4 of the USACE/USEPA Technical Framework (USACE/USEPA 1992). First, the beneficial use needs and/or opportunities should be determined for the specific location. Next, an evaluation of the physical suitability of material for the proposed uses needs to be conducted using appropriate characterization tests for determining the physical and engineering properties in Table 1. If the physical properties do not meet desired specifications, processing the dredged material by addition of available materials such as spent lime, fly ash, or kiln dust should be considered. Many times the dredged material can be conditioned to meet desired specifications. Next, the logistical and management requirements are considered. The evaluation of environmental suitability is then considered. If there is reason to believe the dredged material is contaminated, either the chemical or biological or both characterization tests should be conducted. A modified version of the framework for testing and evaluating for beneficial use applications is presented in Figure 1. If the results of the chemical/biological screening tests indicate the potential for adverse impacts, the dredged material should be treated and then retested for adverse impacts. If adverse impacts are no longer indicated, or if there is no reason to believe the dredged material is contaminated, the beneficial uses can be realized, and the evaluation of socioeconomic, technical, management, and other environmental considerations, either as an Environmental Assessment or an Environmental Impact Statement, is conducted as shown in Flowchart 3-1 of the USACE/USEPA (1992) technical framework. If adverse impacts are still indicated, the dredged material should not be used for beneficial purposes.

SUMMARY: Dredged material can be a valuable resource with numerous potential beneficial uses. Although dredged material is analyzed prior to placement into CPFs, many physical, chemical, and biological processes can continue to occur depending on the prevailing environmental conditions (e.g., precipitation, temperature, biogeochemical factors) around the CPP. The results obtained

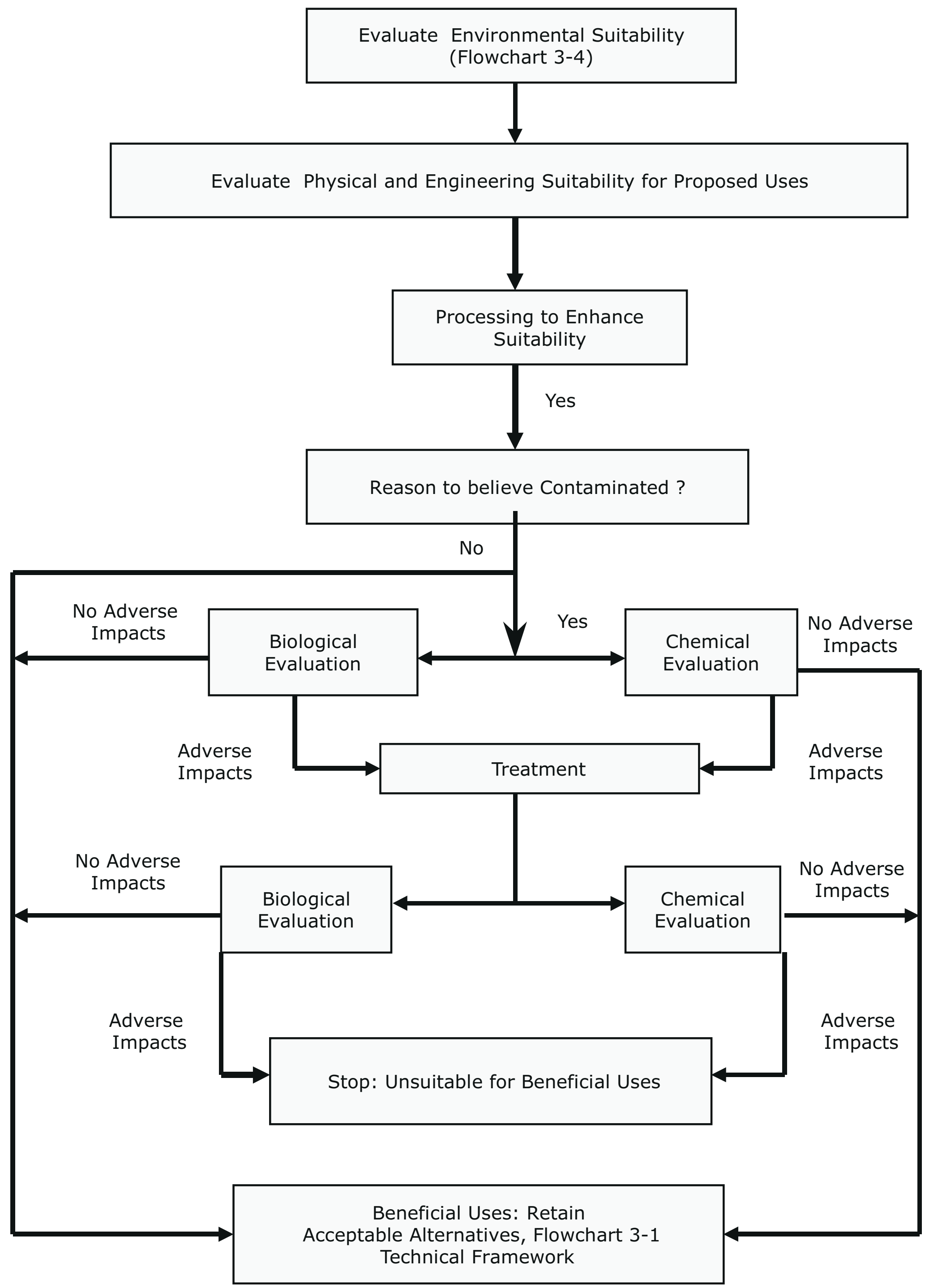

Figure 1. Framework for testing and evaluation for beneficial uses

from the appropriate characterization tests will provide information useful in determining the current physical, engineering, chemical, and biological properties of the dredged material. Knowledge of the properties and the limitations (e.g., contaminant bioavailability) of the dredged material will aid in determining the alternatives for beneficial uses.

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Dredged Material Spatial Management, Analysis, and Record Tool (DMSMART)

PURPOSE: This technical note describes the Dredged Material Spatial Management, Analysis, and Record Tool (DMSMART), a personal-computer- (PC-) based software package being developed to assist Corps staff in managing their dredging and dredged material placement activities. Feedback on its features and implementation is requested. Also described is an existing software package, the Disposal Analysis Network for New York (DAN-NY), currently available from Science Applications International Corporation, which formed the basis for DMSMART.

BACKGROUND: Managing dredging and dredged material placement has become more complicated as the number of regulations applicable to these activities has increased, and resource agencies and environmental groups have subjected the Corps to greater scrutiny on dredging projects. A customized Geographic Information System- (GIS-) based software system can be used to greatly facilitate dredging project management. Recent advances in computer hardware and software have allowed the development of sophisticated, but easy-to-use GISs for PCs.

Challenges faced by the U.S. Army Engineer District, New York, in managing their open-water disposal site, the Mud Dump site, led to their funding development of a district-specific software package for site management, DAN-NY. Delivered in June 1997, DAN-NY was developed as a joint effort between two contractors (Science Applications International Corporation (SAIC) and Applied Science Associates (ASA)) and the U.S. Army Engineer Waterways Experiment Station (WES). Present users of DAN-NY (including the New York District, WES, and SAIC) have all been impressed with its ability to facilitate site management.

WES association with the New York District and DAN-NY development, along with general site management experience, led to the conclusion that a Corps-wide software package for managing various aspects of the dredging and placement process would be valuable. Under the Dredging Operations and Environmental Research (DOER) Program, WES is heading the development of DMSMART. Like DAN-NY, DMSMART will be a GIS-based software package customized for the dredging/placement application, and it will also include several WES models. To effectively use DMSMART once the initial software development is complete, Corps Districts need to begin developing databases of dredging project and placement site monitoring data.

This technical note consists of a description of dredging and placement site management challenges that are well-suited to the capabilities of a GIS-based software system. This is followed by descriptions of the New York District site management difficulties that led to DAN-NY development, DAN-NY specifications, a discussion of DMSMART, and finally a description of the DMSMART implementation plan.

SITE MANAGEMENT CHALLENGES

Federal regulations require that dredging and dredged material placement be done at minimum cost while being consistent with sound engineering principles and proper concern for the environment. Over the past two and a half decades, knowledge of the environmental impacts associated with dredging and dredged material disposal has increased. The emphasis has shifted from one that was most concerned with low cost to a much more balanced view with environmental concerns playing an increasingly larger role in dredging project management. Also, the awareness that dredged material should be considered a resource that can be used beneficially in an increasing number of ways has greatly influenced dredging project management.

For the reasons mentioned above, managing dredging projects is now much more complicated than in the past. In addition to the ever-increasing number of regulations and statutes that govern dredging and dredged material placement, many State resource agencies and environmental groups now subject dredging projects to greater scrutiny. Just doing a good job is no longer sufficient. To improve or maintain its credibility, the Corps must be able to conclusively demonstrate that dredging projects are being effectively managed.

Management of dredging and dredged material placement, referred to hereafter as dredging project management, has a number of facets. Dredging project management provides answers to the following questions:

- What is being dredged?
- How much is being dredged?
- When will dredging take place?
- Where did dredged material come from?
- Where will dredged material be placed?
- How will material be dredged and placed?
- What will happen to the environment at the dredging site? At the placement site?
- Was material dredged correctly? Placed correctly?
- Could dredged material be used more beneficially?
- Could project have been completed at a lower cost?

In more general terms, dredging project management is controlling the dredging project to meet regulatory guidelines of low cost, sound engineering, and environmental stewardship. A more detailed discussion of managing open-water dredged material placement can be found in Walls et al. (1994). An important facet of dredging project management is long-term planning, developing placement options that have sufficient site capacity for the next 20 to 50 years.

The increase in regulations, number of contaminants tested for, and projects for which tests are conducted has vastly increased the amount of data collected during execution of the dredging project. This has resulted in greater numbers of bioassay and bioaccumulation tests. At the placement site, tests for sediment chemistry and tissue chemistry are becoming more routine. Use of sediment profile imagery (SPI) is becoming more routine to detect layers of dredged material at thicknesses below those resolvable from bathymetric surveys.

Dredged material placement is now receiving much greater interest. Confirming that the contractor is meeting contract specifications for placing material in precise locations inside the disposal site (not outside the site, which could potentially damage nearby resources) is considerably more important and more practical. A related issue is the increased time and cost required to designate new sites. This makes controlling placement within the disposal site to maximize site capacity while minimizing environmental impacts even more significant.

The ability to manage all these diverse data and use them effectively meshes well with the strengths of a GIS-based system. A GIS is an excellent tool to archive, display, and analyze spatial data. Many of the difficulties of site management result from the inability to easily access the data and display it on a common datum. Using the spatial nature of the data, the GIS's database can contain the many different types of data in layers that can be easily retrieved and displayed.

In addition to dredging project management, resource agencies and environmental groups have become more involved in the dredging process, resulting in substantial increases in the number of requests for information. Also, the number of lawsuits associated with dredging projects has increased, adding to the number of requests Districts receive for information. Providing timely answers with a minimum of effort can be difficult. The relational database included as part of the GIS allows a range of queries to be made with minimal effort.

Concerns over the fate of dredged material during dredging and during and after placement in the disposal site are increasing. The ability to predict water column impacts during dredging and placement, the area of the bottom covered by a placement operation, the height of the mound created during a placement operation, and the long-term stability of a dredged material mound can all be crucial to obtaining resource agency permission to execute a given dredging project. Reliable prediction of long-term mound stability is critical to both maximizing site capacity and to creating effective site management plans.

Over the years, WES has developed or refined a number of numerical models that predict various aspects of dredged material fate that can be used to address concerns such as those just discussed. However, the ability of District staff to use these models has often been limited by less than user-friendly interfaces combined with difficulties in accessing the data needed to drive the models. A number of the WES dredged material fate models are to be included in DMSMART. Prior limitations on difficulty of use and access of input data will be overcome.

The above discussions show that a GIS software package with access to WES dredged material fate models could facilitate dredging project management. The following section describes the specific site management challenges faced by the New York District that prompted the development of a District-specific open-water site management software system.

DAN-NY

Background

Historically, the New York District has had a difficult open-water dredged material placement site to manage. The Mud Dump site, a 2.1- by 3.7-km rectangle located 11 km east of Sandy Hook, NJ, has been used since interim designation in 1973. The site's proximity to commercial and recreational fishing areas, historic disposal sites, and heavy shipping through the approaches to New York Harbor create a unique set of circumstances from a site management perspective. For most of the time since site designation, the site has received an average of 4.3 M m^3 per year of mostly fine-grained maintenance material (Massa et al. 1996) from an average of 20+ Federal and private projects.

Over the years, challenges in three different areas led the New York District to fund development of the first software package for managing open-water disposal sites, DAN-NY (Clausner, McDowell, and May 1997). The first management challenge was concern over site capacity. The desire to maximize site capacity (and not to exceed safe navigation depths) and contain the sediments inside the site was a major driving factor for developing a computerized GIS system to provide a more sophisticated level of site management. The second concern was the desire to improve capping of contaminated dredged materials placed in the Mud Dump site. The third major need resulted from the variety of locations and media on which the New York District stored information relevant to site management. It was difficult to access and display the data needed to make decisions.

Both WES and SAIC have supported the New York District in their site management activities for many years. SAIC collected a considerable amount of monitoring data at the Mud Dump site and assisted with operational details for capping operations, while WES assisted in capping project design (Randall, Clausner, and Johnson 1994) and computations of site capacity (Clausner and Greges 1995). In 1994, SAIC proposed joint development of a software system, DAN-NY, to assist the New York District with open-water site management. In the joint effort, SAIC's expertise in monitoring and data collection was combined with the strengths of ASA, a firm specializing in hydrodynamic numerical modeling using GIS, and WES' expertise in capping, fate modeling, and site capacity.

Phased Implementation

DAN-NY is being developed in phases. Phase 1 was a system design study, which defined data types, hardware, software, costs, and schedule for implementing subsequent phases. Phase 1 was completed in May 1996 (SAIC 1996). Phase 2 was to design and implement the system including developing and documenting data management systems and training of New York District and WES staff. Concurrent with Phase 2 was Phase 3, which selected the data needed and then populated the databases. Phases 2 and 3 were completed in June 1997. Phase 4, now underway, is to maintain the system, add enhanced software and analysis, and continue populating the database with additional data sets.

DAN-NY functions at two levels. It has quick access to maps and summary information for use by upper level management or in-depth (extended analysis) capabilities for the technical user. Quick access features (available by selecting one or two options from the opening menu) allow the user to view and print any bathymetric surveys in the database along with the more recent barge placement locations. In the extended capabilities mode, the user has access to an array of tools that will apply to many day-to-day activities as well as longer term planning and design related studies. Figure 1 shows the range of tasks that can be done in DAN-NY. In addition to the more obvious abilities to display bathymetric survey data in a wide range of options, DAN-NY can accomplish the following:

- Compute site capacity.
- Predict mound geometry using the Multiple Dump FATE of dredged material (MDFATE) model developed as part of the Dredging Research Program (DRP) (Moritz and Randall 1995).
- Display the mound created and compute volumes.
- Associate mounds with buoy locations.

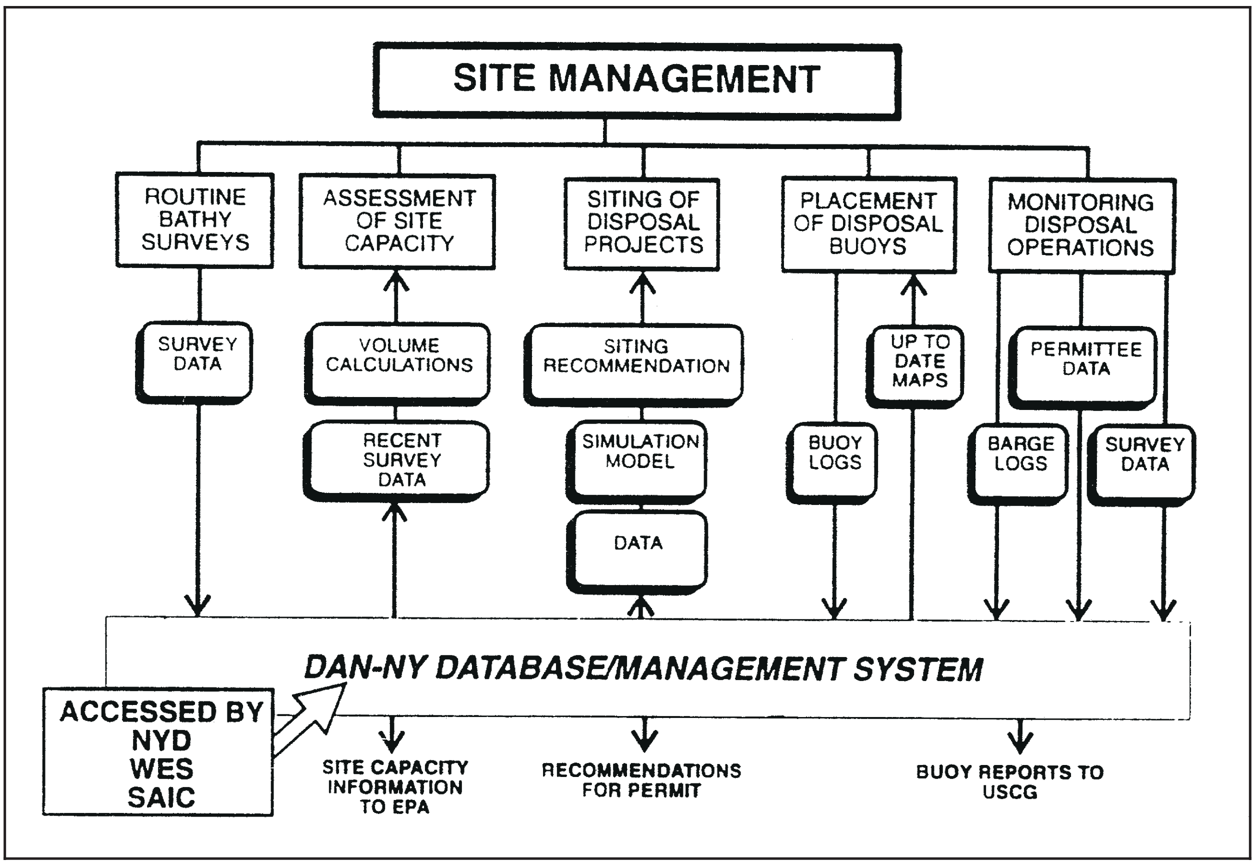

Figure 1. Site management activities supported by DAN-NY

- Review barge disposal logs.
- View SPIs.

DAN-NY Hardware and Software

With the exception of the specialized software applications developed by SAIC and ASA, all hardware and software for DAN-NY are nonproprietary and readily available. DAN-NY is used on a PC with minimum capabilities of a 166-MHz CPU, 32 Mbytes of RAM, 2-Gbyte hard drive, and 6x CD-ROM. All software is 32-bit to increase operating speed; the operating system is Windows NT 4.0; the GIS system is ArcView 3.0; and the database is Microsoft Access. A GIS expert is not required to operate DAN-NY. Most of the functions a site manager would require have already been built in. Present users of DAN-NY were proficient with the software after 2 days of training. Training for the quick access features takes 2-3 hr.

DAN-NY Databases

Table 1 lists the data types and the number of each type of data populated in DAN-NY during Phase 3. SAIC made a considerable effort to meet the METADATA standards now required. All data entered into the database met SAIC's quality assurance/quality control (QA/QC) specifications. All data are provided on CD-ROMs, with periodic updates via new CD-ROMs.

Table 1 **Data Types Initially Included in DAN-NY**
Bathymetry (>27 surveys)
Sediment profile imagery (10 surveys)
Sediment chemical and physical analyses (7 surveys)
Barge disposal logs (1,785 logs)
Side-scan sonar (2 surveys/1 image)
Planform photographs (5 surveys)
Tissue analyses (chemical and physical) (4 surveys)
Disposal buoy locations (645 logs)

DAN-NY Application to the 1997 Capping Project

The beta version of DAN-NY was used to assist in the design of the capped contaminated sediment mound project placed in the Mud Dump site during the summer of 1997 (Clausner et al. 1998). This early version of DAN-NY proved to be extremely valuable in designing the operational plan for placing 253 barge loads containing nearly 530 k m^3 of contaminated material (McDowell et al. 1998). The resulting mound was being capped with approximately 1.5 M m^3 of sand. During the 1997 capping project, DAN-NY's ability to display barge disposal locations, most of which were provided by a barge-mounted silent inspector, proved to be invaluable for managing the project (Pace et al. 1998).

DMSMART

Knowledge of dredging project management challenges and involvement with DAN-NY led WES to propose development of DMSMART under the DOER Program's Comprehensive Open Water Site Management System work unit. DMSMART will build on the experience gained with DAN-NY. Because of the complexity of site management problems, DAN-NY already has many features that will be helpful to other Corps Districts, and will be considered for DMSMART. However, DMSMART will be an improvement over DAN-NY in several key ways. DMSMART will include data on the dredging site in addition to the disposal site. This should greatly increase its utility. In addition to open ocean sites, the types of disposal sites allowed within DMSMART will be expanded to include riverine and estuarine sites. The ability to manage confined disposal facilities will also be included. DMSMART will include access to a greater number of WES models for predicting dredged material fate. DMSMART will be owned by the Corps; therefore, DMSMART software will be available without cost to Corps Districts. Corps Districts will be responsible for funding/developing databases.

Based on experience with DAN-NY and District input, the following concepts will guide DMSMART development. The initial version will be simple, concentrating on including dredging site data and expanding the fate models to include the Short Term Fate of Dredged Material (STFATE) (Schroeder and Palermo 1990, Johnson and Fong 1995) and Long Term Fate of Dredged Material (LTFATE) (Scheffner et al. 1995) models in addition to the MDFATE model. DMSMART will be flexible, so that additional models (e.g., some of the Automated Dredging and Disposal Alternatives Management System (ADDAMS) or DOER models) or other data types can be added later. In developing requirements for DMSMART, features that the majority of Districts agree are necessary will be included. However, if a District has a special requirement, the program and standards should be sufficiently documented so the feature can be added.

The key to maintaining flexibility is to develop standards for data and modeling. Standards will allow the software to be easily implemented Corps-wide, the program to be software independent, and allow the Districts to easily contract data collection and database creation. As part of the DMSMART effort, guidance documents with instructions for electronic formats and standards for data will be provided. Modeling standards will include methods for handling input and output files.

Additional models may be included in DMSMART based on the following principles. First, a significant number of Districts must indicate that a specific model will be useful. Second, a model must not require "in-depth" training for execution. For those models that may be useful to a District for managing dredging projects, but require WES staff for execution, an attempt will be made to include the capability to archive and display the model output file. If a District has developed software or specific applications for dredging project management that can be of general use, an attempt will be made to include the District development. For example, the Seattle District has demonstrated output of an ArcView-based application for tracking and displaying sediment contaminant concentrations. WES expects to use this or a similar application in developing DMSMART.

Another guiding principle is to continue to be aware of other databases and reporting requirements related to dredging project management and to allow DMSMART to extract or import data as necessary. Potential databases with which DMSMART might interact include the Dredging Information System (DIS), the contaminated sediments database, and the regulatory database RAMS (Regulatory Analysis and Management System).

Data Types and Analysis Capabilities Planned For DMSMART

For the dredging site, data types included in DMSMART will be bathymetry, project locations, channel dimensions, sediment grain size data, and project history data such as past contractors and equipment used. If possible, the DIS database will be accessed for project history data. Probably the major effort for dredging sites will be to include the vast amount of sediment chemistry and biological testing data routinely collected. Disposal site data included in DMSMART will be similar to those in DAN-NY listed in Table 1. One of the principal efforts over the next few months will be to finalize the data types and analysis capabilities. Any District staff members that desire a more complete list of data types or analysis capabilities are urged to contact the author directly. A future technical note will provide more details on the data types and capabilities selected for inclusion in DMSMART.

Database Development

Of equal importance to software development is creation of each District's database of dredging project history and the dredging and disposal site monitoring data. Without the data, DMSMART is useless. Districts must populate their own databases using the guidance developed by the work unit. Therefore, one of the early products of the contract to develop DMSMART will be guidance documents on how to create the database, along with cost estimates for creating the database. Based on the number of sites, time, and funds available, each District will be able to decide how much data will go into the database initially, and make plans to have additional historical data entered at a later date. Obviously, data recently collected in electronic format will very likely cost less and require less time to put into the database. Depending on the District's needs and staff, database creation can be done in-house, under contract, or with a combination of the two. One method would be to contract out an initial block of data required for database entry of ongoing projects, then create future databases in-house as funds permit. It is important to assure that data have been QA/QC'd and meet METADATA standards.

Maintaining an up-to-date database will be a continuing activity after DMSMART is on-line. As with the database creation, this could be done in-house or by contractor.

Compatibility with Silent Inspector Data

During the DRP, theory, procedures, and standards were developed for a Silent Inspector (SI) to monitor hopper dredging operations (Cox, Maresca, and Jarvela 1995). The SI facilitates contract monitoring. It consists of a set of standards for collecting information on the dredge, processing this information to obtain dredge state and load, storing the information, and providing the data via reports. Some of this reported information may be transferred in real-time via a cell phone or radio link to the District. The full data set is then downloaded periodically. Under the DOER Program, the SI for hopper dredges will be taken from the prototype system developed under the DRP to a working system for the Districts. In addition, plans to extend the SI to cutterhead and mechanical dredges/barge combinations are planned.

Some portions of the SI data will be quite valuable for inclusion into DMSMART. WES staff developing DMSMART and the SI are working closely so that the archived SI data can be accessed by DMSMART. Once again, a consistent set of standards and intelligent database design will be crucial for ensuring compatibility.

Schedule for Implementation

The present plan is to develop requirements for DMSMART through early CY98 with a scope of work (SOW) completed in spring of 98. A contract is expected to be awarded by early FY99, with delivery of DMSMART 1.0 during the summer of 99. Initial distribution to the Districts and training are planned for Sep-Nov 99.

As noted earlier, one of the first products from the contract will be a set of guidance documents describing how to create District databases. A training course is planned at WES to provide detailed instructions for District staff on database creation. The course would likely be offered in late winter or early spring of CY99.

Steering Committee/District Input

To assist WES staff in developing DMSMART, several different methods will be used. At the workshop, a steering committee was developed. The members are listed below:

- Dr. Tom Fredette (New England District)
- Mr. Paul Bradley (Mobile District)
- Mr. David Kendall (Seattle District)
- Mr. Don Borkowski (Buffalo District)
- Mr. Jim Aidala (Rock Island District)
- Mr. Tom Verna (Headquarters)

The steering committee members will be reviewing in detail the requirements, SOW, etc. Steering committee members will be asked to attend 1-2 meetings to assist in developing requirements. Other Corps District staff who would like to provide input are being solicited. These persons will be provided draft copies of the requirements, etc., and asked to provide comments.

To both inform District and Division staff of DMSMART and gain feedback, WES will be attending various meetings and providing briefings on DMSMART. In early August 1997, WES staff presented a DAN-NY demonstration and DMSMART overview to the Mobile District. In early September 1997, WES presented an overview of DMSMART to the East Coast Dredging Team meeting in St. Augustine, FL, and presented a DAN-NY demonstration and DMSMART overview to the Jacksonville District. Briefings on DAN-NY, DMSMART, and the SI were provided to

Seattle, Portland, and San Francisco Districts in December 1997. Other briefings are planned; interested readers should contact Mr. Clausner directly.

SUMMARY

Computer hardware and software have now advanced to the point where a GIS-based software package customized for managing dredging projects is a reality. The New York District has recently funded development of a District-specific software package (DAN-NY) for managing their open-water disposal site. DAN-NY has proved its value during a contaminated sediment capping project conducted during the summer of 1997. Under the DOER Program, a Corps-wide software package for managing dredging projects (dredging and disposal) is now being developed, the Dredged Material Spatial Management and Record Tool (DMSMART).

POINTS OF CONTACT: For additional information on DMSMART, contact the author of this technical note, Mr. James E. Clausner (601-634-2009, *clausnj@ex1.wes.army.mil*) or the DOER Program Managers, Mr. E. Clark McNair, Jr., (601- 634-2070, *mcnairc@ex1.wes.army.mil*), or Dr. Robert M. Engler (601-634-3634, *englerr@ex1.wes.army.mil*). This technical note should be cited as follows:

> U.S. Army Engineer Waterways Experiment Station. (1998). “Dredged material spatial management, analysis, and record tool (DMSMART),” Technical Note DOER-N2, Vicksburg, MS.

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DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

AUG 27 1999

REPLY TO
ATTENTION OF

Programs and Project Management Division
Project Management Branch

Honorable Jeb Bush
Governor of Florida
Tallahassee, Florida 32399-0001

Dear Governor Bush:

The U.S. Army Corps of Engineers is committed to examine future construction and maintenance projects in the Tampa Bay area to see if material can be used to construct a nearshore berm at Egmont Key. The material must be predominately sand to construct a berm that will stay in place and meet water quality requirements. Egmont Key must be the least cost method of disposal since the Corps does not have any funds to place material at Egmont Key.

We are currently examining an upcoming maintenance project at St. Petersburg Harbor to determine if any material can be used at Egmont Key. The sediment testing is underway and will be completed by September 1999. The results of the sediment testing will determine if the material can be placed at Egmont Key in an economically and environmentally acceptable manner.

Future projects will be examined to determine if material can be used to help ease the effect of erosion at Egmont Key. Any questions can be directed to myself or Mr. Richard E. Bonner, Deputy District Engineer for Project Management, at 904-232-2586.

Sincerely,

Joe R. Miller

Joe R. Miller
Colonel, U.S. Army
District Engineer

Copy Furnished:

Ms. Catherine Florko, Department of Environmental Protection, Marjory Stoneman Douglas Building, 3900 Commonwealth Boulevard, Mail Station 310, Tallahassee, Florida 32399-3000

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

JUN 0 1999

Programs and Project Management Division
Project Management Branch

Honorable Bob Graham
United States Senator
Attention: Ms. Kristen Kershner
2252 Killearn Center Boulevard
Third Floor
Tallahassee, Florida 32308

Dear Senator Graham:

The U.S. Army Corps of Engineers is committed to examine future construction and maintenance projects in the Tampa Bay area to see if material can be used to construct a nearshore berm at Egmont Key. The material must be predominately sand to construct a berm that will stay in place and meet water quality requirements. Egmont Key must be the least cost method of disposal since the Corps does not have any funds to place material at Egmont Key.

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Future projects will be examined to determine if material can be used to help ease the effect of erosion at Egmont Key. If you have any additional questions or need additional information, please call me or have your staff contact Mr. Joseph Burns, Congressional Liaison, at 904-232-2243.

Sincerely,

Joe R. Miller

Joe R. Miller
Colonel, U.S. Army
District Engineer

CESAJ-CO (1130) FEB 1 2 1996

MEMORANDUM FOR STAFF CHIEFS AND SPECIAL ASSISTANTS

SUBJECT: Disposal of Sand at Beaches or Nearshore From Maintenance Dredging Projects

1. There has been concern raised as to whether we have a consistent policy dealing with disposal of sand from maintenance dredging projects. The basic policy is to place all Beach Quality Material (BCM) on beaches consistent with Federal Policy.

2. The purpose of this MFR is to confirm our policy and strategy for placing sand on the beach and confirm criteria to address additional costs.

3. Federal policy within the Corps of Engineers on dredging is defined by both the Code of Federal Regulations and Engineering Regulations. Within the Code of Federal Regulations, the Final Rule for Discharge of Dredged Material into Waters of the U.S. or Ocean Waters, is found at 33 CFR Parts 209, 335, 336, 337, and 338. Within the Engineering Regulations Dredging Policies and Practices, Interim Guidance is found at ER 1130-2-107.

4. Our interpretation of this National Policy guidance has been consistent with what we have interpreted to be the Federal Standard. The Federal Standard is defined at 33 CFR 335.7 as, "...the dredged material disposal alternative or alternatives identified by the Corps which represent the least costly alternatives consistent with sound engineering practices and meeting the environmental standards established by 404(b)(1) evaluation process or ocean dumping criteria."

5. The least cost environmentally acceptable alternative has always been to place the material as close as possible to the channel in an environmentally acceptable manner. Placing sand on the beach has always been part of that policy and standard. In 1990 and 1991, we reiterated this policy in discussions with the State while discussing Long Range Dredged Material Management Strategies and Water Quality Certificate issues.

6. With this policy in mind, we have established a Base Plan for every project for disposal of dredged material. This Base Plan satisfies the environmental standards as expressed through the 404(b)(1) guidelines and the NEPA process. With environmental criteria satisfied, we always look for ways to dispose of dredged material for Beneficial Uses. As this relates to sand, we ALWAYS seek to place sand

on the beach as a first option and nearshore as a second option.

7. The placement issue arises when the disposal of sand on the beach or in the nearshore is not the least costly alternative, but is consistent with sound engineering practices and meets environmental standards. In these cases the non-Federal interest must contribute 100 percent of the added cost of disposal above the least costly method, unless a particular job for a project has been approved for cost sharing pursuant to Section 933 of WRDA 1986. In either case, the non-Federal interest must provide all necessary lands, easements, rights-of-way and relocations required for disposal of maintenance dredged material from the navigation project.

8. Sound engineering practice dictates that we place sand within the Littoral drift if environmentally acceptable and if environmental windows allow safe economical operation. Economical operation is a function of each dredging project and cannot be oversimplified. However, one of the economical rules of thumb is a 5-mile limit for pumping distance. Large, cutter-suction dredges can economically dredge and place material within a 5-mile radius of a dredging site.

9. Based on this, the following "rule of thumb" will be used:

a. If a beach placement area is located within 5 miles of the dredging site, we shall place sand as:

(1) First priority on the beach.

(2) Second priority in the nearshore.

(3) Third priority in upland Confined Disposal Area (CDA).

(4) Fourth priority in the Offshore Dredged Material Site (ODMDS).

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